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S. D. KIRKPATRICK, *Editor*

October, 1930

Straws in the Wind

LATELY it has been our privilege to study a reliable index of the recent production records of a dozen typical plants in the process industries and to compare their outputs with those of corresponding months of 1929. Frankly, there were some surprises. Business is not nearly as bad for these chemical firms as "the enthusiastic hearse drivers" have tried to make us believe. Nor is it as uniformly good as the rosy views put forth by some of the professional optimists.

FOUR of the group—a petroleum refinery, two organic chemical plants, and a fine chemical producer—averaged 28 per cent above the record for the corresponding months of 1929. The remaining eight averaged 18 per cent below last year; yet five of these—two heavy chemical plants, another oil refinery, a paint and varnish factory, and a specialty plant—fell behind by only 10 per cent or less, while the three others, representing textile, leather, and fine organic chemicals, were operating at rates of 20, 40, and 45 per cent below 1929. The unweighted average for the whole group of 12 companies is off but 3 per cent. Considering that 1929 was a record year for most chemical industries, such a showing is indeed encouraging. Chemical industry is not depression-proof, but because it is diversified and comparatively flexible, business is good for those chemical firms that are aggressively making it so.

IN AUGUST we detected and reported in these columns the first signs that a few wary buyers were quietly laying in supplies of raw materials. Chemical prices,

it seemed to us, were at or near the bottom, having levelled off after the steady decline that began last October. Measured by *Chem. & Met.'s* weighted index (base 100 for 1927) prices dropped from 100.19 in September, 1929, to 94.15 in August. September showed a very slight increase (to 94.38) with the return this month to 94.13. These low prices have been made possible largely because of improved technology. A little study shows that caustic soda is now quoted at the lowest price since 1917. Soda ash prices are also the lowest since 1916. Ammonium sulphate at \$1.85 compares with \$2.45 in 1914. Sulphuric, nitric, and muriatic acids are all below pre-war prices. Chlorine, borax and formaldehyde are at the lowest prices ever quoted for these commodities. Is it any wonder that there has been appreciable buying of chemicals by those who are willing to invest in the future?

THAT FUTURE is bright for chemical industry. Right now we are in a period of transition. We have completed a business cycle in which the construction and automobile industries have been the dominating influence. We are entering a period when other developments will characterize our progress. There is reason to believe that, basically, these will be of a chemical nature, whether in the field of fuel production and utilization or in the further extension of synthetic processes and products. Chemical industry stands ready to gain materially in the new order of business. Therefore, should it not be the one to strike out boldly and lead the way toward business recovery?



EDITORIALS



OCTOBER, 1930

"The Outlook For Chemicals"

THERE probably is no other American manufacturing industry which furnishes a better example, than the chemical industry, of our rapid industrial growth since the war and of the extent to which the great post-war 'boom of creative thought' has been commercialized and capitalized by far-sighted business leadership. This industry is most basic to practically all other industries, and their technical progress is almost inconceivable without a corresponding growth of the leading manufacturers of chemicals."

No less an authority than Moody's Investors' Service published this paragraph on Aug. 29, 1930, as an introduction to a review of the chemical industry securities entitled "The Outlook for Chemicals." This recognition of the importance of the chemical industries is not surprising to chemical engineers; but it is gratifying to note that the fundamental inter-industry influence of our activities is beginning to be so well appreciated in the financial and business world. This appreciation, however, brings with it a responsibility.

This responsibility is clearly emphasized in the same stock-market letter from which the quotation is taken. "Risks in an industry of this character are legion" is but one of the statements stressing this point. The importance of diversification in products and in industrial activity, the necessity of continuous research and of alertness in meeting competitive materials, and the vital necessity of a full knowledge of the entire industry from raw materials to ultimate markets, all are responsibilities of chemical engineering managements.

Fortunately, in our industries, even during the current period of restricted business, these factors for stability and long-time welfare have been in the minds of chemical executives. There has been almost no tearing down of research organizations or scattering of well-organized sales staffs. Even at the risk of currently reduced profits these vital technical forces have been retained. This retention speaks well for the prospects of renewed industrial activity during the coming year or two. It is a well deserved, and a highly appreciated, basis for personal confidence among technical men connected with chemical engineering establishments.

Speeding Up Action Under the Flexible Tariff

A NEW set of rules of practice and procedure for handling cases under the flexible tariff provisions of the recent law has been announced by the Tariff Commission. By this new procedure the burden of initiating comprehensive action rests on the interested party who

cares to make appeal. Such appellant must now make something of a definite showing in support of a request for modification of duties, either up or down, in order to start machinery for adjustment. Thereafter the action of the Commission will be much more that of a judicial body than hitherto.

Members of the Commission informally indicate the hope, and expectation, that the new procedure will greatly speed up final action on flexible-tariff cases. One well-informed individual estimates that the time required for the formal application and settlement by the Commission may be cut to about one-third or one-quarter of that hitherto found necessary. If the new rules accomplish nothing more than this speeding up of the procedure they will amply justify the new arrangement.

Placing the revision procedure more on the basis of a public case under judicial supervision promises also to be an important development. The history of society shows no better way in which to settle human differences than by public trial before competent individuals of judicial temperament, with all interested parties having reasonable opportunity to be heard. The establishment of such a procedure in tariff negotiations is a step away from politics and therefore in the direction of progress.

Nitrogen Picture In Rosier Hues

WITH CHARACTERISTIC showmanship our brilliant contemporary, *Fortune*, has recently portrayed the world nitrogen situation from a number of interesting viewpoints. One of its representatives was among the party of American editors, agricultural professors, and others who were the guests of the Chilean industry during its centenary celebration. Another, accompanied by a most competent photographer, inspected and described the great synthetic plant of the Leunawerke of the German I. G. An account of the recent Paris and Berlin conferences tells how the nitrogen world was put in its place, while the fourth article of the series attempts a little synthesizing on its own account by courageously putting together the highly speculative cost data that go to make up a balance sheet for the Chilean industry under the new Cosach plan of reorganization.

Such a striking presentation of this important subject is decidedly worth while, if for no other reason than to show even the casual reader that there are two sides to the nitrate problem. The rather glowing account of the Chilean industry is partly balanced by the picture of the immensity of the German synthetic operations—yet it is greatly to be regretted that the American nitrogen industry was not more adequately presented. There are reasons, well known to editors, why it might not have been possible to describe the largest of our domestic plants, but certainly the reader is entitled to a better picture of what has already been accomplished in this country. After all, America is the battleground on which the synthetic vs. natural nitrate issue is very likely to be decided.

As the writer of the Cosach article clearly recognizes, however, the question of ton costs is the crux of the whole competitive situation. Hence the attempt to build up the complicated balance sheet for the Chilean nitrate combine. Unfortunately, in the matter of the "hoped-to-be-realized" per ton cost under the so-called Guggenheim process, the writer appears to have been poorly advised. The figure given is \$4 per short ton at the plant, as com-

pared with \$12 as the direct cost under the older Shanks process. When it is considered that this \$4 must cover the cost of removing overburden, mining and screening approximately ten tons of caliche, transporting the oversize to the plant, crushing and extracting the nitrate from both the coarse and the fines, disposing of perhaps nine tons of residue, crystallizing the ton of nitrate, remelting and spray-congealing the final product—then it must be apparent to anyone that miracle workers have been busy at Maria Elena. Nowhere else, to our limited knowledge, is there a precedent for such a remarkable performance. If, on the other hand, the actual "to-be-realized" cost should be around \$8, as we have been led to believe, the figures under the Cosach setup come more nearly in line with those previously discussed in *Chem. & Met.* It is, of course, a simple matter to add \$3, or \$4 or \$5 to the figures in the *Fortune* table. We question, however, whether the average investor—or banker either—will have the technical advice that will lead to such a decision, and after all, we must remember that someone is going to have to put up the money for the great Cosach experiment.

Sustaining the Spirit of Safety

EACH YEAR as the annual Safety Congress chalks up a new record in attendance, its influence spreads to ever-widening fields. Earlier this month, 7,000 delegates left the Pittsburgh congress with an enthusiasm kindled by hundreds of stirring sessions, discussions and demonstrations. Surely such a show of interest in the safety movement is impressive. Yet it carries with it just one element of danger—the possibility of reaction. Extremes are particularly undesirable in so vital a matter as safety. There should be no let-down. Not only the spirit but the practical every-day performance must be sustained. Good safety records are matters of persistent, continuous hammering at the problems of the plant. Nowhere does eternal vigilance command a higher premium.

Modernizing Mental Equipment

CHEMICAL ENGINEERS in the industries of the metropolitan New York area have shown genuine interest in the announcement of an educational experiment now being tried out at Cooper Union. During the fall and winter months chemical engineers who were graduated before systematic instruction was offered in this field are invited to attend a lecture course in the unit operations of chemical engineering. In addition, a supplementary course in modern physics will be conducted by an eminent physicist and will be available to the chemical engineers. Since the lectures are given in the

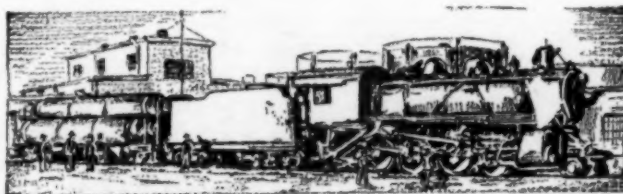
evenings, there is no interference with the industrial occupations of those who wish to acquaint themselves with modern theories and practices. Prof. A. B. Newman and Cooper Union are doing a worth-while service to the profession of chemical engineering, and their work is deserving of widest support and commendation.

An Opportunity for International Service

WHATEVER may have been the true cause, or combination of causes, of the R-101 disaster—the storm, overloading, structural weakness, or faulty judgment on the part of the command—experts are in agreement that the crash would have been far less serious had the lifting gas been helium rather than hydrogen. Why helium was not used is an old story by now—our helium monopoly and export ban, of course, are responsible. At the time when the 69th Congress passed the helium conservation law, it was unquestionably fully justified in so doing. As a matter of national defense it was imperative that the then limited helium reserve be conserved and kept out of the hands of possible potential enemies. This situation has now changed. Although we are still legally within our rights in banning helium exports, world good and the advancement of aviation demand that the proscription be lifted, pending of course, the advent of any situation where the element of defense would become of importance.

That this can be done without imperiling our helium reserves is now generally recognized. It was much to the credit of Rear Admiral Moffett, of the Navy Bureau of Aeronautics, that he was the first to come forward with the suggestion. Estimates of the helium supply now range from sufficient for Army and Navy requirements for the next 200 years to supplies practically limitless. Nobody knows, of course, how much there is, but it is an encouraging fact that such estimates usually have been found to fall short of the actuality.

Making helium available for export will involve no change in the law. Indorsement by the Secretaries of War, Navy, and Commerce, and approval by the President are all that is necessary; and this is as it should be. No change in the law is desirable. There has, in fact, already been a small quantity of helium exported for experimental purposes. But as a consequence of the R-101 disaster, it is to be expected that there will be other applications for considerable quantities, which will no doubt be granted. Pending these applications, an offer emanating from the government would be taken as a most sincere gesture of international friendship, and as such cannot be too strongly urged. Helium export would not only permit our one private producer to resume his interrupted business but it would do much to hasten the day when this newest form of transportation might truly be said to have left the experimental stage.



Nitric Acid Produced From Ammonia

By Modified Pressure System

By GIACOMO FAUSER

*Industrial Engineer
Novara, Italy*

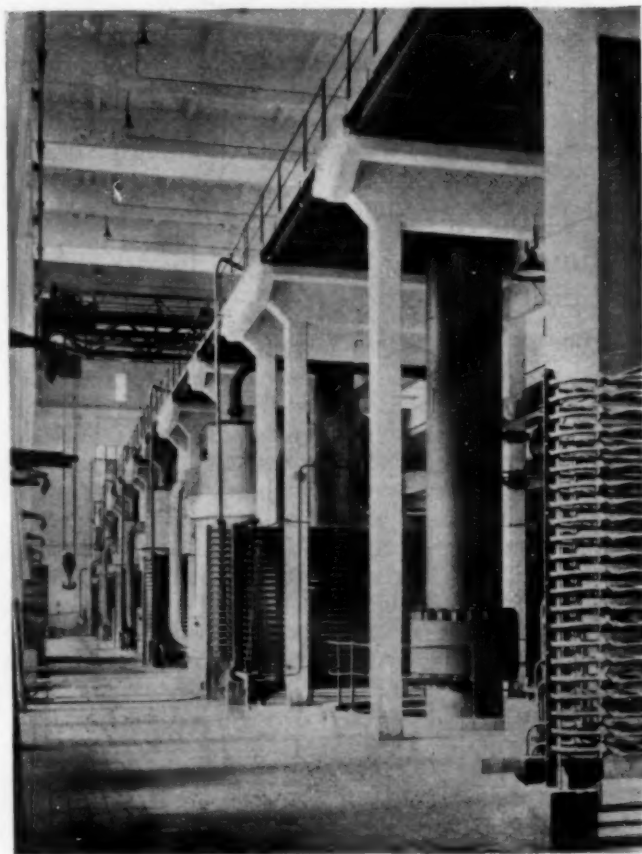
The author of this interesting work on ammonia oxidation has long been associated with Continental progress in industrial chemical synthesis. Born at Novara in 1892, he attended the Royal Polytechnic Institute at Milano and during the War made studies on water electrolysis for hydrogen. By 1920 he had begun work on his first synthetic ammonia plant, which, since going into operation in 1922, has been followed by numerous others in such countries as Italy, Germany, Japan, and Switzerland. In connection with these plants he has been a pioneer in ammonia oxidation.

INVESTIGATION of the fundamentals of ammonia oxidation must center largely around the precise advantages of pressure, in the light of the practice developed by the author since the publication of his paper on the subject in *Chem. & Met.*, 35, 1928, 474. For, in spite of the preconceived idea that the use of pressure entails excessive technical complications, the superiority of the pressure method meanwhile seems to have asserted itself. The capacity of the installations already in service ranges up to 150 tons of nitric acid a day, which can be doubled without difficulty.

The continually decreasing cost of synthetic ammonia has made the production of nitric acid from this source an attractive expedient, although the older installations under atmospheric pressure required very large equipment, especially the absorption towers. Because the oxidation of NO to NO_2 increases with lowered temperature, it was also undertaken to cool the gases below 0 deg. C.; but apart from the ensuing complications, this method entails an excessive expenditure of energy.

On the other hand, very interesting observations were made in catalytic oxidation at normal pressure, with absorption of nitric gases under pressure. From Fig. 1 it is evident that, if the temperature decreases from 30 deg. C. to 0 deg. C., the time necessary for achieving a 95 per cent conversion, with gas containing 10 per cent of NO , decreases by about one-half; whereas if the pressure increases from 1 to 1.8 atm. (involving the same expenditure of energy), the time necessary for the same degree of oxidation, at a temperature of 30 deg. C., is reduced by about one-quarter. Consequently, the absorption system can be reduced proportionally in the two cases.

Although these advantages in the use of pressure have been known for a long time, it was not until the last few years that large industrial installations were put in operation. In the first of these, the ammonia was oxidized under pressure in order to avoid compression of the oxides later. Since then this method has been abandoned,

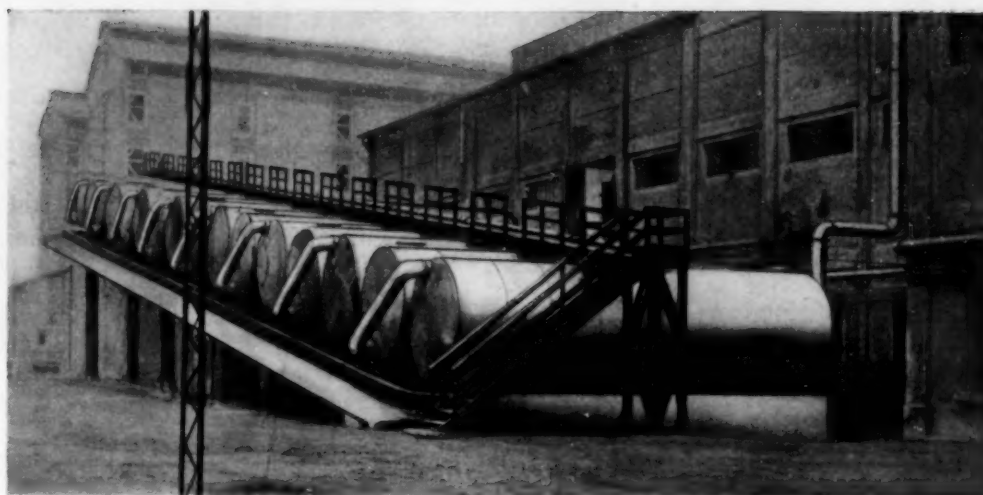


Synthetic Ammonia Plant Supplying Finished Raw Material for Nitric Acid Production

preference being given to oxidation at atmospheric pressure with compression of the catalyzed gases after cooling and condensation of water vapor. The recent progress in chrome alloys has surmounted the difficulties inherent in the construction of turbo-compressors for nitric gases, an achievement that has, more than any other, permitted a satisfactory solution of the problem.

Without going again into the theory of ammonia oxidation, it has been found that the conversion at atmospheric pressure is considerably greater than that at a pressure of several atmospheres, a result proved in a long series of experiments on an industrial scale. In these experiments platinum was considered the most practical catalyzer for the reaction. Because the oxidation is a function of temperature and pressure, and, other things being equal, the temperature varies directly with the ammonia content, a definite gaseous ammonia mixture must exist which gives the maximum yield. In the

Absorption System in
Nitric Acid Plant With
Daily Capacity of 60
Tons



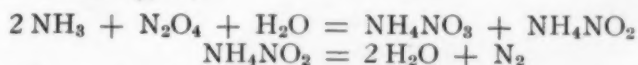
wide experiments conducted at both atmospheric and elevated pressures, the most favorable conversion was attained at about 850 deg. C., and remained constant up to about 950 deg. It was not feasible to push the temperature any higher, because the deterioration of the platinum increases rapidly.

From the heats of reaction it is easy to calculate that 850 deg. C. is attained when the concentration of ammonia is about 11 per cent. But in oxidizing with air, one may not exceed 9.5 per cent of ammonia, wherefore the optimum temperature must be obtained by using some of the heat of reaction to preheat the ammonia-air mixture before catalysis. If oxygen is available, it can be used to enrich the air to 24-25 per cent of oxygen, increasing the allowable ammonia content to 11 per cent and allowing direct attainment of the optimum temperature with its higher yield of nitrogen oxides.

Not only the temperature of the platinum gauze but also the rate of flow per unit surface of the gauze has an important function. At each pressure there is an optimum flow at which the conversion of a given composition attains a maximum. In experiment it was found that the highest conversion was 91 per cent at 4 atm. pressure, while at atmospheric pressure, 95 and even 96 per cent can easily be obtained.

Taking the mean of results obtained over a long operation, the values in Fig. 2 are obtained. It will be seen that not only is the maximum conversion well above that

This law does not cover the whole question, for it was found that an increase of pressure increases the percentage of unoxidized ammonia, which reacts with the oxides to give ammonium nitrite, later decomposed in the absorption:



Although under pressure the same platinum gauze can oxidize a greater quantity of ammonia, the gain in the amount of platinum used does not wholly justify the loss of ammonia under pressure, which represents more than the interest and amortization. The additional expense of platinum, moreover, is partly compensated for by the saving in oxidizing equipment, which in pressure catalysis is often excessive.

With the platinum gauze very susceptible to poisoning by the air-ammonia mixture, it is interesting to observe that while regeneration at atmospheric pressure is necessary only after six or seven months of operation, in pressure operation the interval is much shorter. This is the more regrettable because the cleansing in the latter case is much more arduous and difficult than in the former. The presence of iron is known to be very harmful to platinum even in small quantities: traces of iron oxide seriously affect the conversion. The combined effect of air-ammonia mixtures, humidity, carbon dioxide, and the turbulence tends to carry particles of

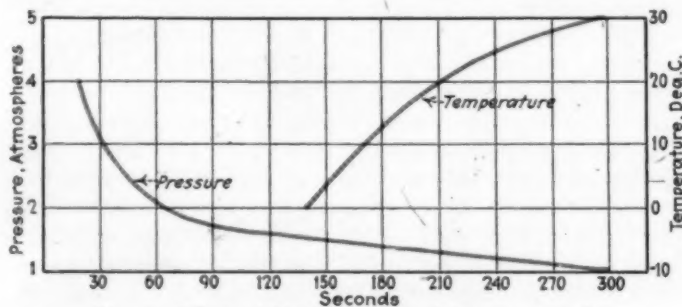
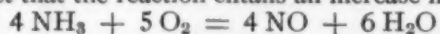


Fig. 1—Effect of Temperature and Pressure on the Rate of Oxidation of NO

at elevated pressures but also that the flow can be varied within wide limits without a great variation in the coefficient of conversion. This contrast finds its explanation in the fact that the reaction entails an increase in volume:



which, according to the laws of equilibrium, is favored by a decrease in pressure.

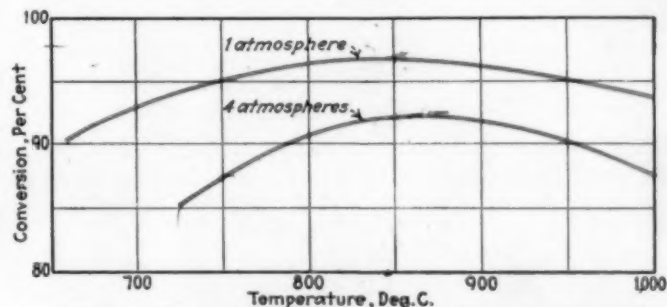


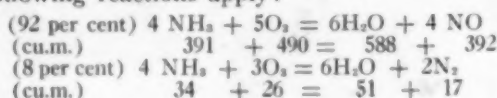
Fig. 2—Effect of Pressure on the Oxidation of Ammonia at Different Temperatures

iron in a fineness that is most difficult to separate. Filters, reagents, and electrostatic methods have all proved extremely cumbersome and impractical. Another advantage in favor of normal pressure is the ease with which the catalyzers can be preheated by a hydrogen flame, while the pressure vessels entail difficult complications.

IN ORDER to produce one ton of nitric acid, calculated at 100 per cent, 270 kg. of ammonia must be oxidized, theoretically; assuming an approximate conversion of 90 per cent, it will require 300 kg.—that is, about 425 cu.m. at 25 deg. C. and normal pressure. The mixture sent to the oxidizers will have the following composition, with a specific weight of 1.23:

NH ₃	11 per cent	425 cu.m.
O ₂	22 per cent	870 cu.m.
N ₂	65 per cent	2,510 cu.m.
H ₂ O	2 per cent	75 cu.m.
	100 per cent	3,880 cu.m.

If the oxidation yield then turns out to be 92 per cent, the following reactions apply:



The mixture leaving the oxidizer will have the following composition:

H ₂ O	17.9 per cent	714 cu.m.
NO	9.8 per cent	392 cu.m.
O ₂	8.9 per cent	354 cu.m.
N ₂	63.4 per cent	2,527 cu.m.
	100 per cent	3,987 cu.m.

After cooling to 25 deg., the partial pressure of water vapor will be 0.178 atm. and the tension at this temperature 0.0323 atm., hence

$$\frac{0.178 - 0.0323}{0.178} \times 714 = 580 \text{ cu.m. of water vapor}$$

will be condensed; and an oxidation of 75 per cent of the NO can easily be obtained, which would involve a

decrease of $\frac{392 \times 0.75}{2} = 147.0$ cu.m. of oxygen, since



At a temperature of 25 deg., 20 per cent of the oxide polymerizes, corresponding to a reduction in volume of

$$\frac{0.2 \times 294}{2} = 29.4 \text{ cu.m., since}$$



The gaseous mixture entering the compressor then will have the following composition, with a specific weight of 1.34:

NO	98 cu.m.	3.0 per cent
NO ₂	235 cu.m.	7.3 per cent
N ₂ O ₄	29 cu.m.	0.9 per cent
O ₂	207 cu.m.	6.4 per cent
H ₂ O	134 cu.m.	4.2 per cent
N ₂	2,527 cu.m.	78.2 per cent
	3,230 cu.m.	100.0 per cent

It is evident that instead of compressing 3,880 cu.m. of gas before catalysis, it is now possible to achieve an economy by compressing 3,230 cu.m. of catalyzed gas after cooling.

It may be objected that the price of a compressor for the nitric gases is much higher than the one necessary for compression before oxidation, but it must be borne in mind that the moist mixtures of air and ammonia also attack iron easily, so that ordinary steels would scarcely suffice here either. Furthermore, the same compression can be obtained after reaction with fewer stages of compression. The increase in pressure in a stage of a compressor is approximated by the formula:

$$\Delta p = \gamma H_t$$

in which H_t expresses the theoretical height of the gas column to be compressed and γ its specific weight. For

a constant peripheral speed, H_t is constant; in order to attain the same pressure, all other things being equal, the

number of stages can be reduced in a ratio of $\frac{1.23}{1.34}$,

according to the specific weights.

Summarizing, the reduction in volume of gas to be compressed after catalysis, and the fewer stages of compression, permit an appreciably smaller compressor and an economy which largely compensates for the use of special steels.

CONCENTRATION of the acid obtainable by the absorption of oxides in water, all other conditions being equal, depends on the concentration of peroxide in the mixture. If a gas very poor in N_2O_4 comes in contact with an acid of a certain concentration, the latter instead of increasing may even decrease. Under a pressure of 3 to 4 atm., the speed of catalytic oxidation and of polymerization of the peroxide is so great that even in a minimum cooling period, a large fraction of the peroxide, up to 25 per cent of the total quantity, has time to be absorbed in the condensed water and consequently the final maximum concentration of the acid is equally reduced. Contrariwise, in oxidation at atmospheric pressure only a small fraction of the peroxide is absorbed by the condensation water, so that the peroxide content of the gases on entering the absorption system is much higher and allows a much higher final concentration of acid.

Since in nitric acid manufacture by far the most important costs are those of the absorption system, the object was to develop a new system more rational for

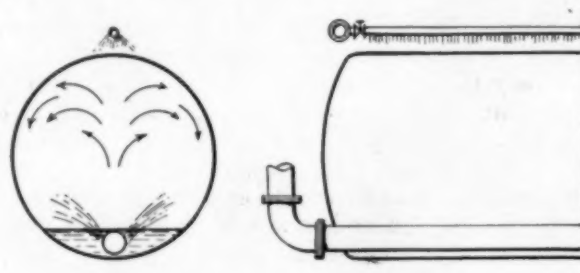
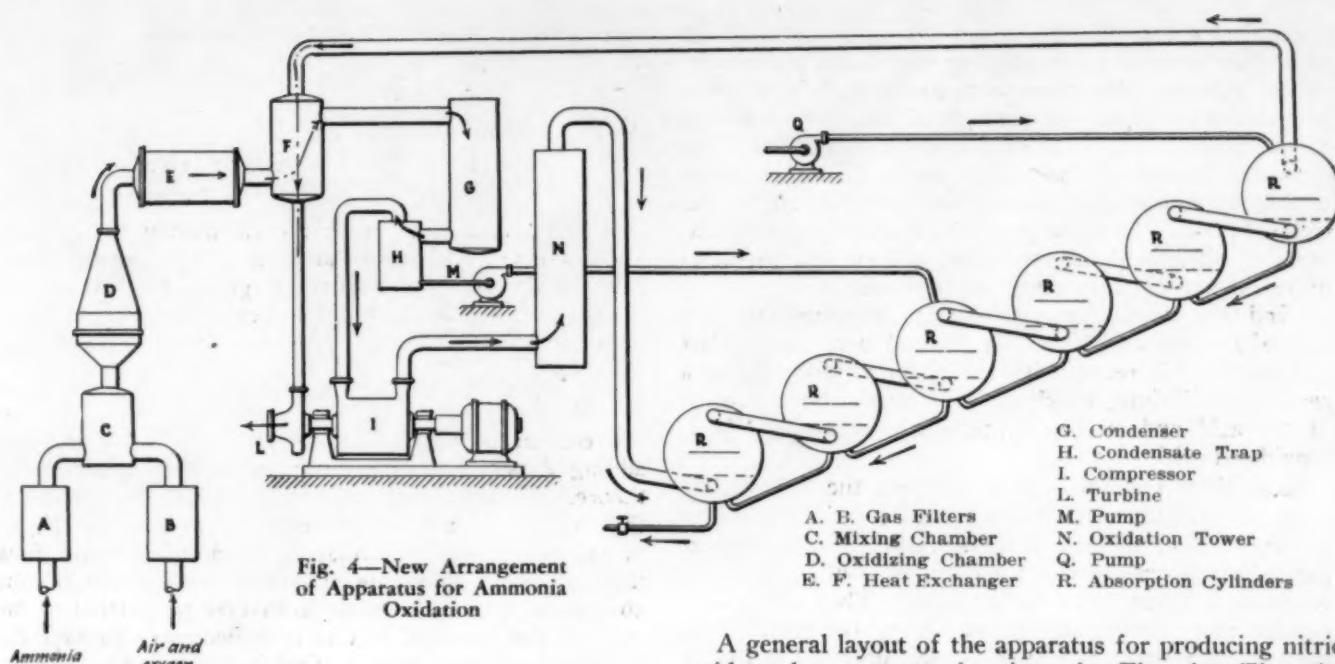


Fig. 3—Detail of Absorption Unit

industrial installation than the old method. The main defect of the old towers is the fact that even the greatest regularity of sprinkling does not keep all the surface of the packing wet, because the falling liquid has a tendency to reunite into streams, so that actually only a small part of the packing surface is effectively wetted.

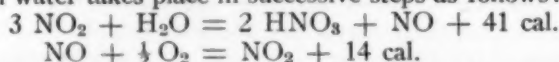
Furthermore, the loose packing not only offers a great resistance to the passage of gas, with a consequent loss in compression, but also exerts a dangerous force on the sides of the towers. But another factor unfavorable to the use of towers is the rising temperature, which adversely affects absorption. The reaction of nitric gases and water proceeds with the discharge of considerable heat, which must be eliminated proportionately if the reaction is to proceed. Because an exterior heat exchange on the walls would be of negligible aid, one must resort to an intensive circulation of the absorbing liquid and be content to cool the hot acid outside.

Besides the great power expended in the pump, this method is not satisfactory because it does not prevent the tower temperature from rising at least a dozen degrees above the temperature of the circulating liquid. The only means of attaining a constant temperature in the



tower, therefore, seems to be the use of a refrigerant. Incidentally, the packing of the tower means a corresponding reduction in the volume of reaction chamber (for the oxidation of NO to NO₂), therefore it is necessary to make the towers larger to allow the gases the desired degree of oxidation. For example, a packing of quartz of 5 cm. mean diameter leaves only 40 per cent space free; substituting Raschig rings 50x50 mm. and 5 mm. in thickness, the free space would be 70 per cent.

And so it was deemed preferable to devise a newer system than the tower method. Because this has been achieved to a degree exceeding expectation, and because no description has appeared up to the present, a detailed study will now be given. The reaction of nitric oxides with water takes place in successive steps as follows:



The first reaction is reversible and when the temperature rises it proceeds to the left with decomposition of nitric acid. In the second case, however, the temperature coefficient of reaction is negative; that is, with rising temperature the oxidation of NO slows down. Consequently, a rational absorption medium should satisfy the following conditions:

1. The gases should have as complete a contact as possible with the water.
2. The heat of reaction should be removed in the degree in which it is formed.
3. After absorption of nitrogen peroxide, there must remain enough time to let the regenerated NO become oxidized again.

The absorption design which was developed is shown in Figs. 3 and 4. It consists of a horizontal cylinder of special steel, resistant to nitric acid, the dimensions being variable according to the output of the installation. The lower part of the cylinder is filled with acid and serves to absorb the nitrogen peroxide, while the remainder is empty and permits a successive oxidation of the nitric oxide. The dimensions of the system are thus at least 30 per cent smaller than those of towers, because there is no packing. The compressed gases enter a pipe within the cylinder and escape through a series of holes under the level of the acid; this accomplishes a perfect contact between the gas and the acid.

A general layout of the apparatus for producing nitric acid under pressure is given in Fig. 4. The air, ammonia, and if available, the oxygen, are carefully filtered at A and B to assure a long life for the catalysts: thereafter all piping is made of aluminum. Manometers indicate the clogging of the filters.

After being mixed in chamber C, the gases are sent to the oxidizer D. This equipment has no radical modifications, but judicious choice of materials and slight modifications are exercised out of regard for the catalysts and to inhibit decomposition of the ammonia. Enlargement of the diameter of the oxidizing chambers has allowed the use of large units, while decreasing their number. The control is very simple, comprising a continuous analyzer of the ammonia concentration in the mixture, and a pyrometer giving the oxidation temperature. Uniform composition of the mixture, indispensable for a good exploitation of the catalysts, is assured by automatic equipment.

The catalyzed gases are first sent to a boiler, E, and then passed through the heat exchanger, whereupon they are cooled in the condenser, G. The weak acid condensed in H is pumped into the absorption system, while the gases are compressed by the turbo-compressor, I, into the oxidation tower, N, whereupon they enter the series of cylinders R.

Washing is accomplished by water injected into the last cylinder by pump Q. The residual gases leaving the last cylinder are used in the heat exchanger, F, and then help in the recovery of energy by use in the turbine, L. Analysis of the gases at the entrance and exit of each cylinder renders an exact check on the efficiency of the absorption system.

The loss in washing in absorption is extremely slight; it may be less than 0.8 per cent without alkaline treatment. The system has further advantages; for example, the elimination of pumps for the circulation of washing acid, and of refrigerant for nitric acid, since the absorption cylinders are cooled directly. Then the absorption of nitric acid under pressure yields directly concentrations of 40 to 42 deg. Bé., an important point when the acid has to be concentrated up to 48 deg. Bé., because the cost in sulphuric acid for dehydration becomes less than half of that in the case of 36 deg. Bé. acid. It may be added that the operation of plants under pressure is as easy and regular as those under normal conditions:

it requires a few minutes to put them in operation, but then they proceed practically without supervision.

The cylinders for absorption are joined in a series provided with pipes for passage of the gas from one to the other. The U-tubes form a hydraulic seal for the gases, permitting the acid to run in a contrary sense to the gases, for which reason the cylinders are on the inclined plane. Thus the gases are washed by concentrations of nitric acid in proportion to their concentration of nitric oxide. Inspecting any cylinder of the series, we find that the gas coming from the preceding one consists of a mixture of NO, NO₂, O₂ and inert gases. Part of the peroxide reacts with the water until it attains a certain equilibrium, which depends on the concentration of the acid and on the temperature, until the NO is reoxidized with oxygen.

Since these reactions are exothermic, the temperature increases and the equilibrium shifts to a diminution of absorption, but the rise in temperature also makes the gases lighter and carries them up in contact with the water-cooled surface of the cylinder. They are cooled, become more heavy, and descend along the side. Thus the gas has a circulation such as that indicated in Fig. 3. Finally, it should be added that the droplets of acid projected by the gases strike the cold walls and provide a heat exchange of considerable proportion. Actually the exchange is more than 30 times greater than that between the gas and the cylinder wall alone.

IN DESIGNING the system just described, it was seen from the equations (on the previous page) that only two-thirds of the peroxide absorbed by the water becomes nitric acid, while one-third goes back to NO; furthermore, only a fraction of the peroxide can be absorbed, depending on the concentration of nitric acid, the temperature, and the pressure. Under the best practical conditions, the equilibrium is attained with an acid of 42 deg. Bé.; therefore the quantity of peroxide absorbed decreases as it approaches this limit.

While it is not the purpose of this article to examine in all detail the complicated theory underlying the absorption, it should be helpful to inspect the fundamentals underlying the system that was here developed. Letting $2a$ represent the nitric oxide content on entrance to the cylinder, $2x$ the fraction oxidized to NO₂, α the fraction absorbed by the acid, based on the theoretical amount, then the coefficient β of absorption of the cylinder is given by the equation:

$$\beta = \alpha \frac{2}{3} \cdot \frac{x}{a}$$

The speed of oxidation of NO is given by the follow-

ing equation, in which C is the concentration of oxygen:

$$\frac{dx}{dt} = K(a - x)^2(C - x)$$

By integration

$$t = \frac{1}{K(C-a)^2} \left[\frac{(C-a)x}{a(a-x)} + \log \frac{C(a-x)}{a(C-x)} \right]$$

It is convenient to refer the calculation to the production of one ton of acid an hour. It has already been established that the quantity of gas coming from the compressor will be 3,230 cu.m. per hour; that is, 0.897 cu.m. per second. Then if V is the volume of a cylinder,

$t = \frac{V}{0.897} p$; the mean value of the constant of speed

of reaction between 2 and 4 atm. is $K = 37$; and adding 2 per cent excess oxygen to correspond to its theoretical quantity, $C = 1.5a + 0.02$. On this basis the volume of the cylinder necessary to give the degree of oxidation may be calculated. Such calculations show that, all other things being equal, the volume of the absorption system decreases in inverse proportion to the cube of the pressure. It is now necessary to find the coefficient of absorption α ; that is, the relation between the NO₂ sent through and the NO₂ absorbed. An exact coefficient, however, is extremely difficult to obtain, because it depends not merely on the usual physical factors but also on the degree of peroxidation and new equilibria for every condition. But by parallel experiments figures have been found which allow the use of an equation representing an increase in concentration of the acid with a remarkable exactitude:

$$y = A(1 - e^{-Bx})$$

where A is a limiting value of the acid as the quantity of peroxide available becomes infinite, x is the number of liters of peroxide, and B is a factor depending on the temperature. From this equation can be calculated the variation of the coefficient of absorption with the concentration of the acid.

According to experiments, if the concentration is 36 deg. Bé. and the temperature about 28 deg. C., the mean coefficient of absorption of the cylinders at a pressure of 3 atm. is $\beta = 0.21$. Hence if an absorption of 95 per cent is required, the number of cylinders is given by the equation:

$$1 - (1 - \beta)^n = 0.95, \text{ giving the result of 12.}$$

If a conversion of 99 per cent is required, however, 19 cylinders will be necessary. Thus the influence of the absorption on cost of installation becomes manifest.

In the old installation one preferred not to absorb the last traces of oxide, because the dimensions of the tower became so extravagant that the cost could not be recovered. The alkaline treatment also has not justified itself, while under a pressure of 3 atm., 19 cylinders serve to reduce losses to only 1 per cent.



Nitric Acid Absorption System Yielding 150 Tons Daily. Detail of Unit is Shown in Fig. 3



**St. John X-ray Machine
Developed for Routine Testing
of Welded Vessels**

All electrical equipment and tubes are housed in the portable cabinet which is moved along the vessel as the sections of the weld seam are photographed for examination

Testing Welded Construction During Production

EDITORIAL STAFF ARTICLE

PRACTICALLY universal acceptance of welded construction for chemical engineering equipment has resulted, in a large measure, from the comparative ease and thoroughness with which the completed work may be tested. For example, in the case of pressure vessels for chemical industry, hydraulic tests may be made at any pressure up to the elastic limit of the metal, obviously impossible with riveted joints, which begin to leak at much lower stresses. X-ray examination, electromagnetic testing, fatigue determination and many other methods of weld testing are also available, but only recently that has it been possible to combine these in practical, production-scale routine.

At the Barberton (Ohio) works of the Babcock &

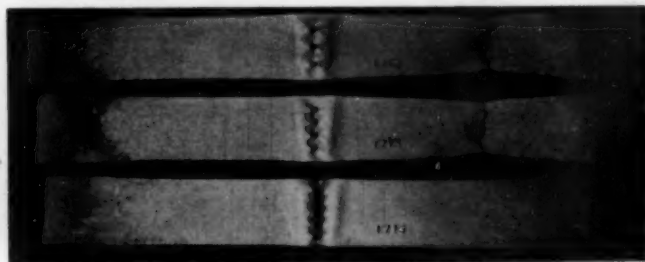
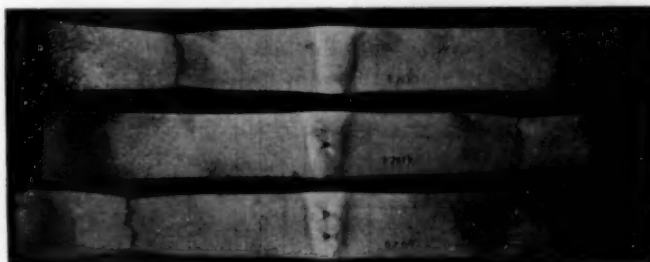
Wilcox Company, such a control procedure has been put into operation in connection with a new technique of electric arc welding developed by the company as a result of its own research. The St. John X-ray machine shown here is the first to have been set up in this country for the routine factory inspection of welded seams in pressure vessels, heat exchangers, and similar equipment. It will be observed that the entire equipment is housed in a special portable cabinet. An 18-in. section of the weld is photographed at each exposure as the X-ray apparatus is moved along the longitudinal seam, or in the case of circumferential seams, as the vessel is rotated in front of the cabinet. The X-ray photographs reproduced on the following page are samples of the results obtained with this machine.

Electromagnetic tests are made at Barberton with the

Six Tensile Test Specimens of Electrically Welded A.S.M.E. Firebox Plate

In order to make these fall in the weld it was necessary to drill five $\frac{1}{8}$ -in. holes through the seam.

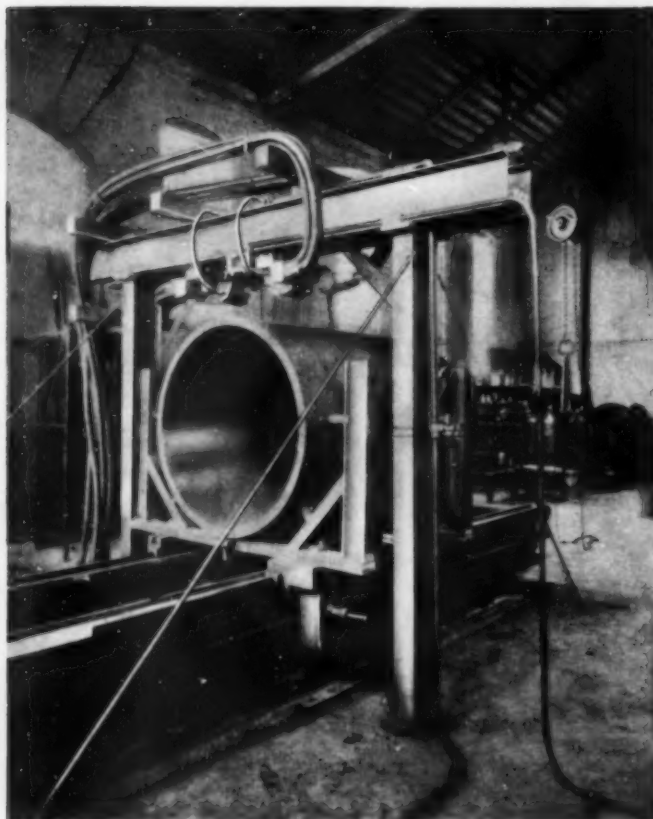
The ultimate strength of these A.S.M.E. firebox weld metal specimens was 74,200 lb. per square inch.



Sperry apparatus shown in the accompanying illustration. In this machine an electric current is passed through the weld, thus setting up a magnetic field, the form of which is affected by any defects in the weld. Such variations are picked up by a balanced magnetic coil and transmitted through suitable relays to a recording apparatus.

In one series of fatigue tests made at Barberton, water under high pressure was alternately admitted to and ex-

Sperry Electromagnetic Testing Apparatus
for Locating Defects in the Weld



Physical and Chemical Characteristics of B. & W. Weld Metal
Compared With A.S.M.E. Plate

	Minimum	Maximum	Average
Ultimate tensile strength (lb. per sq. in.)			
Weld metal.....	65,000	74,500	67,500
Plate metal.....	55,000	65,000	.....
Yield point (lb. per sq. in.)			
Weld metal.....	40,000	55,000	45,000
Plate metal.....	.....	.....	ultimate
Elongation in 2 in. (per cent).....	20.5	38.0	28.0
Reduction of area (per cent).....	32.0	65.0	40.0
Charpy impact values (ft. lb.)			
Weld metal.....	20	45	28
A.S.M.E. boiler plate.....	19	33	20

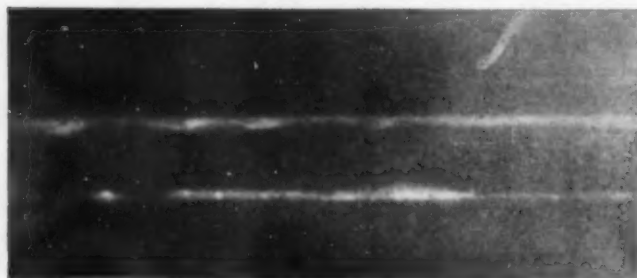
Chemical Analysis (in per cent)

	B&W Weld Metal	Ordinary Arc Weld Metal
Sulphur.....	Less than 0.04	Less than 0.04
Phosphorous.....	Less than 0.04	Less than 0.04
Manganese.....	0.30 to 0.60	Less than 0.20
Carbon.....	0.08 to 0.15	0.02 to 0.08
Nitrogen.....	Less than 0.02	0.10 to 0.14

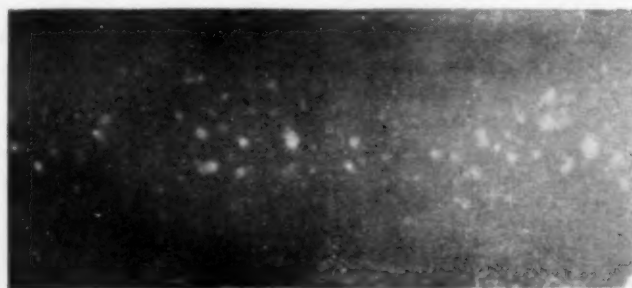
hausted from the vessel under test. Welded drums withstood without failure a number of pressure applications at 16,500 lb. per square inch stress across the welded seam. In another series of fatigue tests, specimens were set in rotating beam machines, subjected to reversed stresses, and the endurance limit of the weld was determined. These indicated endurance limits of about 30,000 lb. per square inch, as opposed to 28,000 lb. for boiler-plate steel. One specimen was subjected to 13,697,400 cycles at a calculated stress of 23,100 lb. per square inch without failure. Another withstood over 10,000,000 cycles at 30,000 lb.

In addition to these production-scale tests on the welded equipment, chemical and photomicrographic analyses and the usual tensile, elongation, bend, and impact tests have been made in order to determine the characteristics of the weld metal deposited by the new process. In all cases the welds were shown to be equal to or better than the plate metal in tensile strength, shock resistance, ductility, and the ability to withstand repeated stresses. In order to make the tensile specimens fail in the weld it was necessary to drill holes through the seam. As shown on the opposite page, five $\frac{1}{8}$ -in. holes were required. The ultimate strength of this welded A.S.M.E. firebox plate was 74,200 lb. per square inch. Other significant test data are shown in accompanying table.

X-ray Photographs of Welds of Varying Characteristics



The weld shown above is unsatisfactory, as indicated by the defective fusion with the metal of the adjoining plates



Above—Although there has been apparently perfect fusion of weld metal and adjoining plates, the defects in the strip of the weld metal would cause doubt as to the quality of the weld



The homogeneous character of the weld metal and the perfect fusion with adjoining plates indicate an excellent specimen of welding

Electrochemists in Detroit

Discuss Corrosion

EDITORIAL STAFF REPORT

IN SEPTEMBER, the Detroit section was host to the American Electrochemical Society for the third time, and this meeting undoubtedly was the most successful and enjoyable one of the three. In spite of seriously conflicting meetings of the metallurgists and foundrymen held at Chicago the attendance exceeded 300, due largely to a number of attractive features, notably the round-table discussion on high-test gray iron, with Dr. Richard Moldenke presiding; the symposium on the prevention of corrosion of metals in the automotive industry, with Dr. F. N. Speller in the chair; the very interesting experimental demonstrations of the new photovoltaic cells; the visit through the Ford Village; and, last but not least, the entertainment on the Canadian shore.

Within the last six years the automotive industry has undergone a number of radical changes in the construction, design, and general appearance of cars. The familiar nickel plate has vanished and in its place the ever bright and more lasting chromium plate has appeared; the high chromium-nickel alloy, the so-called "18 and 8," resistant to corrosion under severe conditions has been incorporated in the structure of a number of cars; and stronger tungsten-chrome alloys have made possible a further reduction in cross-section of important mechanical parts.

Karl Pitschner, chief chemist of the Firestone Steel Products Company, Akron, Ohio, presented the first paper of the corrosion symposium, entitled "A Proposed Method for Accurately Evaluating Results of Corrosion Tests of Ferrous Metals." The methods used to determine the extent or rate of corrosion of samples of iron or steel have never as yet attained the degree of accuracy reached in the testing of the non-ferrous metals. Pitschner's recommended procedure depends on a method of determining the element iron in the metallic portion of corroded samples by means of a separation of corrosion products from metallics with crystalline iodine. Discussing the results obtained by Pitschner with his new method, Dr. Speller emphasized the importance of standardizing methods and units so as to be better able to compare results of various authors and laboratories.

EXPERIMENTAL data were presented by C. L. Hippensteel and C. W. Borgmann, of the Bell Telephone Laboratories, on the rates of corrosion of electroplated zinc, zinc alloy, and cadmium-protective coatings on steel in an industrial atmosphere, and in a similar atmosphere but accelerated by additional rainfall simulated by a water spray. These data show that zinc and zinc-alloy coatings corrode at a slower rate than

cadmium coatings. However, under the accelerated exposure the difference is not so pronounced.

M. R. Thompson, of the U. S. Bureau of Standards, pointed out that when using the zinc sulphate bath a very fine grained deposit was obtained in the presence of dextrine, but that the grain of this was not as fine as that obtained from zinc cyanide baths. It would seem that the finer the grain the greater the protective value of the plate. Dr. William Blum, of the Bureau of Standards, referred to tests made by the U. S. Navy which indicated that cadmium was superior to zinc. Oliver W. Storey, of the Burgess laboratories, Madison, Wis., cited the case of two intertwined strands of fence wire, one heavily and the other lightly galvanized. The heavy zinc coating protected the exposed or thin parts on the other wire. Prof. Arthur K. Graham stressed the importance of the over-voltage as a factor. Others participating in the discussion included Pitschner; Dr. C. G. Fink, of Columbia University; George B. Hoga-boom, of Matawan, N. J.; Wm. M. Phillips, of the General Motors laboratories; and E. R. Schneidewind, of the University of Michigan.

OBSERVATIONS on the corrosion of aluminum by alkali was reported by Storey. A peculiar case of pitting of aluminum electric-oven walls was investigated. The corrosion of the aluminum was found to be caused by the caustic soda of the sodium silicate adhesive used for the built-up asbestos insulation, in the presence of excessive moisture. The sheet asbestos acts as a dialyzing membrane for the sodium silicate and allows silicate-free caustic soda to reach the aluminum sheet. Dr. Francis C. Frary, director of the research laboratories of the Aluminum Company of America, commenting on Storey's findings, related a number of instances coming under his own observation and emphasized that sodium silicate was an active reagent as far as aluminum was concerned. Dr. J. D. Edwards, also of the Aluminum company, declared, however, that the addition of a trace of water glass to sodium carbonate solutions will inhibit the corrosion of aluminum in such solutions. Finally, the condition of the surface of the aluminum sample was a factor, Dr. Fink pointed out. A good protective oxide coating retards the action of the silicate of soda.

An unusually interesting communication for the symposium was received from Prof. Edgar Newbery, of the University of Cape Town, South Africa. He had investigated the electrode properties of stainless steel. Samples of a pure commercial iron, stainless steel, and electrothermally prepared chromium were compared.

When no current passed, an electrode of stainless steel behaved like metallic chromium. When made cathode, stainless steel behaved like pure iron and showed no resemblance to chromium. When made anode, stainless steel behaved like chromium at low-current densities and like iron at high-current densities, the change of properties occurring quite suddenly. Stainless steel or stainless iron appears to be specially suitable as an electrode for the controlled electrolytic reduction or oxidation of certain substances.

Prof. O. P. Watts, of the University of Wisconsin, displayed a long series of photographs showing how automobile radiator shells should and should not be plated. Heavy electro-deposits on steel were prescribed, to insure lasting protection against corrosion. The proper preparation of the steel surface preliminary to plating is an important factor. The actual thickness of various copper, nickel, and chromium deposits was determined microscopically. Tests were made for pinholes and cracks in the plates and finally samples were immersed in a 35 gram-liter NaCl solution. Many specimens were in good condition after 23 days' immersion.

Professor Watts' paper aroused considerable discussion. Prof. E. M. Baker, of the University of Michigan, felt that all commercial plating should be controlled by visual inspection to discover thin areas. Dr. Speller referred to his recent talk with Professor Desh, who recommended lead as an underplate for nickel and chromium.

H EAT-TREATMENT of chromium deposits to increase resistance to corrosion was covered in a paper by R. J. Wirshing, of the General Motors Corporation. Copper panels chromium-plated at the low-current densities and high bath temperatures were more resistant to calcium chloride corrosion than panels plated at higher current densities and/or lower temperatures. Greater corrosion resistance is attributed to lower hydrogen content of the plate. Upon removing most of the hydrogen through heat, a seven-fold improvement in corrosion resistance was noted.

The final paper of the symposium was by H. C. Mougey, also of the General Motors Corporation, on calcium chloride testing of electroplated parts. Calcium chloride has become a common dust and puddle constituent on many of the automobile highways. It is much more corrosive to plated parts than sodium chloride. However, no quantitative relation between the salt-spray test and the calcium-chloride-spray test could be established. Calcium chloride will attack chrome-plate more easily than sodium chloride, due possibly to the interaction of the carbonic acid of the air with the calcium chloride, forming free hydrochloric acid. The calcium-chloride-spray test was recommended to the chromium-plating industry as an aid in developing a more resistance chrome plate.

L. B. Grant, of the Dow Chemical Company, took exception to the findings of the General Motors research laboratories' findings as to the difference in pH between the NaCl and the CaCl₂ solutions used in the spray tests. Tests at Midland, Mich., indicated that the pH of the two solutions approached the same value, and rather rapidly on severe aeration of the solutions, as is common practice in spray testing. Schneidewind reported that heat-treating not only increased the corrosion resistance of the chromium-plated steel, but furthermore, softened the plate. Dr. E. B. Sanigar, of Columbia University, believed that the hardness of the chromium

was due to the presence of the hydrogen which was removed during heat-treatment. W. W. McCord, of the McCord Radiator Company, Detroit, emphasized the importance of insisting on a minimum thickness of plate for good lasting protection of the surface underneath. William G. Harvey, of the Aluminum Company, strongly advocated the intermittent corrosion test in place of the spray test; results were so much more reliable.

P RESIDENT Kahlenberg presided at the session Friday morning. Dr. A. C. Krueger submitted results that he and Dr. Kahlenberg had obtained with their gas electrodes: The effects of oxygen, hydrogen, nitrogen, helium, and argon upon the potentials of all the common metals and carbon were studied in KCl, KOH, and HCl solutions. The potentials observed were compared with one another. A striking effect noted was that the potentials of the following metals are only slightly affected by any of the gases, no matter which of the three electrolytes was used: arsenic, natural graphite, coconut charcoal, cadmium, mercury, molybdenum, lead, silicon, tin, tantalum, tellurium, tungsten, and zinc.

All the experimental data collected demonstrate clearly that there is no such thing as a gas electrode and that the so-called gas electrodes are really gas-metal electrodes. The presence of a gas affects the potential of any metal. This effect is highly specific, and varies with the nature of the gas, the metal, and the electrolyte.

The potential effects noted apparently have nothing to do with valence, or the usual position of the elements in the periodic systems; nor is it possible to arrange such potentials in hard and fast series of any kind. On account of their specific nature, and because of the unusual behavior of the various electrodes studied, these phenomena deserve further detailed study. Especially is this true of the effects produced by such gases as argon and helium, which are supposed to be chemically inert. Argon and helium have been found to produce fully as characteristic potential effects as hydrogen, oxygen and nitrogen. If argon and helium are really inert gases, this would mean that the potentials are not due to chemical affinity. If it be insisted that the potentials are produced by chemical affinity and are a function of the latter, it would follow that argon and helium are not inert gases, as has hitherto been held.

Dr. Sanigar emphasized the difficulties encountered in removing the last traces of hydrogen and oxygen from the solutions and suggested that these gases may have been present in a number of the cases recorded. Prof. Dwight K. Alpern, of Swarthmore College, supported Dr. Sanigar and related experiences and difficulties in removing the last percentages of hydrogen from neon.

Prof. A. H. W. Aten together with M. Zieren, of the University of Amsterdam, Holland, studied the poisoning of hydrogen electrodes, using arsenious oxide as a standard poison. It was found that commercially pure sodium hydroxide and sulphuric acid contain a substance which has a poisoning action on platinum electrodes.

Dr. R. M. Burns lauded the careful work of the Dutch scientists and mentioned that it was essential to take into account the impurities in solutions in which the electrodes of platinum were used. Overlooking these impurities, though small in concentration, has often led to discordant results. Dr. Kahlenberg recommended that we abandon the term "poison" in the case of plati-

num, because it is incorrect and most misleading.

Sherlock Swann, Jr., and E. O. Edelmann, of the University of Illinois, measured the hydrogen overvoltages in glacial acetic acid. The overvoltages of hydrogen on several different cathods with varying current densities were determined in a 20 per cent sulphuric acid solution in glacial acetic acid. They were found to be much greater than the corresponding overvoltages in aqueous sulphuric acid under the same conditions.

Next followed Dr. Newbery's paper on the theory of electrodes and, as might have been expected, there were a number who did not subscribe to Professor Newbery's conclusions, that:

1. Normal electrode potentials are periodic functions of the atomic numbers of the elements, and those of the inert gases probably are zero.

2. When a gas is liberated at an electrode, transfer resistance always appears, and is due to the purely ohmic resistance of a film of gas under high pressure, covering the electrode.

3. Under the same conditions, overvoltage usually, but not always, appears. This is due to the formation of compounds of the liberated gas with the material of the electrode, under the influence of the high pressures present.

4. Valve action occurs when the anodic compound is insoluble in the electrolyte and an electrical insulator, forming a covering film which is permeable to hydrogen ions but impermeable to the anions present.

5. Passivity occurs when the anodic compound is insoluble in the electrolyte, and is also an electrical conductor.

PROFESSOR Ferguson found that all measurements made by the commutator method are average values subject to various errors and therefore are not reliable. With a newly designed rotating commutator, reliable, reproducible results were obtained. The researches at Michigan University do not justify the assumption of the existence of the so-called "transfer resistance." Dr. Kahlenberg suggested that the effect of light on the electrodes would also influence the voltage readings.

M. deKay Thompson and N. Promisel, of the Massachusetts Institute of Technology, recorded their experiments and findings on the conductivities of sulphur dioxide—water mixtures. The conductivities were determined for concentrations between 8 and 22 per cent of dioxide. Conductivities lie between 0.046 and 0.076 reciprocal ohm for a centimeter cube. If it is attempted to make higher concentrations two solutions result. The conductivities rise with the concentration without passing through a maximum. On the conductivity-temperature graph for an 8 per cent solution, there is a maximum at 30 to 32 deg. C. For higher concentrations this maximum moves to lower temperature, reaching 20 deg. for a 20 per cent solution.

Commenting on the above findings, D. E. Ackermann, of the research laboratories of the International Nickel Company, described tests made with Fe-Ni-Cr alloys exposed to 5 per cent sulphurous acid solutions. It was found that even small quantities of sulphuric acid in solution brought about corrosion of alloys that were resistant to the "ous" acid. The presence of the "ic" acid would also affect the electrical conductivity.

Dr. J. E. Lilienfeld, of the Ergon Research Laboratories, Malden, Mass., presented in detail the results of painstaking research and study, carried out by him to-

gether with L. W. Appleton and W. M. Smith, on the high-voltage anodic layer on aluminum. The work covered a wide range of concentrations of electrolyte, temperatures, and current densities.

A fascinating experimental demonstration was given by Professor Alpern with a new photovoltaic cell (*Electronics*, vol. 1; October, 1930). The cell was of the type $\text{Cu}:\text{Cu}_2\text{O}:\text{Pb}(\text{NO}_3)_2:\text{Pb}$. The sensitivity of the cell was 150 microamp. per lumen. The current characteristic vs. illumination was linear between 0 and 100 lumens per square foot. The cell had a selective characteristic, with a maximum response at about 4,600 Å. When operated in a talking motion-picture projector, the cell responded to audio-frequency light variations with no noticeable distortion.

IN the absence of Prof. G. A. Hulett, of Princeton, his associate, Dr. W. C. Gardiner, reported on the hydrolysis in standard cells. A record was presented on voltage readings on Weston standard cells constructed by Carhart and Hulett in 1904. The voltage dropped slightly during the first few years of this 25-year period, but since 1906 has remained constant. It was concluded, therefore, that cells made according to the specifications laid down 25 years ago are reproducible to at least 10 microvolts. All observations recorded indicate that there was a slow diffusion of the dissolved mercurous sulphate to the cadmium-amalgam anode. Cadmium sulphate hydrolyzes normal mercurous sulphate. A detailed explanation is given of the changes with time taking place in the standard cells.

Prof. Warren C. Vosburgh, of Duke University, took exception to the statement in the report of Hulett that "the problem of obtaining and maintaining a definitely reproducible acidity in the Weston cells has not been solved." Cells made up at the university containing 0.01 mol of sulphuric acid per liter have behaved very well.

The concluding paper of the Friday session was by Carl H. Morken on the Detroit rocking electric furnace as applied to the production of high-test gray iron. Utilization of the electric furnace has enabled the small as well as the large foundry to produce high-test gray iron. Operating data and costs were given, with the properties of the iron. The rocking action of this furnace has a marked effect upon the properties of the iron. With this furnace, high-test gray iron can be produced at costs below those of cupola iron.

Saturday morning was probably the most animated of all sessions. Professor Graham, of the University of Pennsylvania, presided. Over thirty members participated in the discussion. Characteristic of this session were the papers on the deposition of alloys: iron-nickel alloys from cyanide solutions by L. E. Stout and Jonas Carol, of Washington University; nickel-cobalt alloys from sulphate solutions—producing a deposit whiter than ordinary silver—by Dr. Fink and K. H. Lah; lead-thallium alloys—highly resistant to acids—by Dr. Fink and C. K. Conard, Jr. Then there was a lengthy debate on nickel, Phillips maintaining that better results were obtained at low pH's than at 5 and above, the universally accepted standard. Dr. Fink and F. A. Rohrman recorded their findings on electrolytically produced pure nickel. Dr. L. C. Pan proposed a new method of calculating throwing power. Dr. Sanigar discussed the dangers and errors in the determination of cyanide in silver plating solutions.

The spring meeting of the society will be held at Birmingham, Ala., April 23, 24, and 25, 1931.

Recovering TUNG OIL

From Nuts Grown in

By W. H. BEISLER

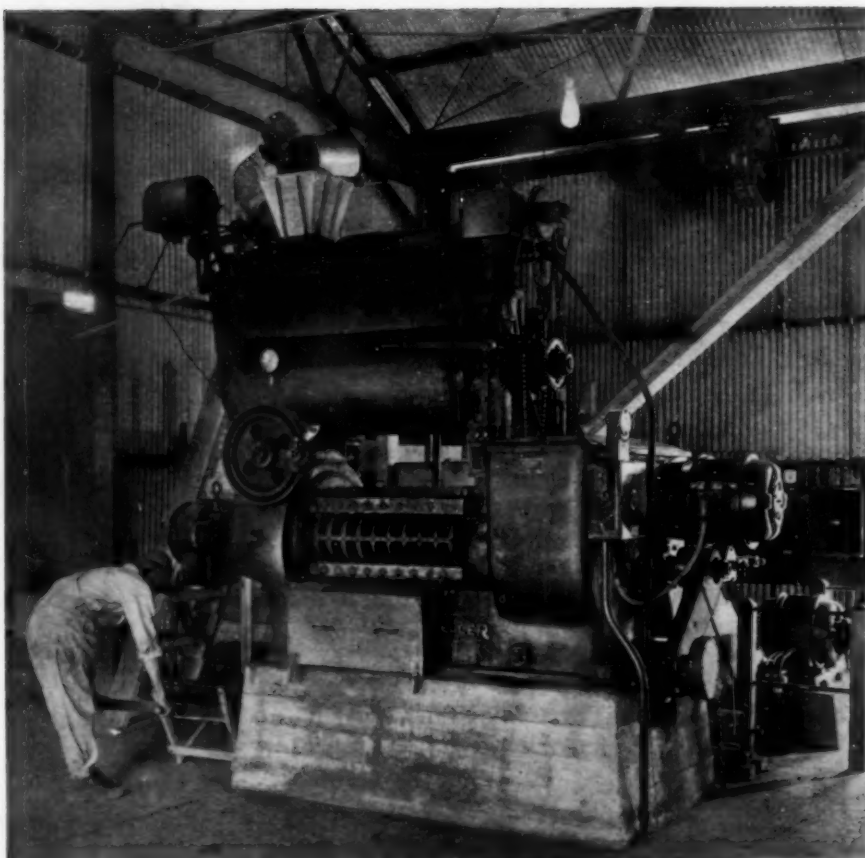
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TUNG OIL, or chinawood oil, is a drying oil that is being used in constantly increasing quantities in the production of spar varnishes, linoleum, electrical insulations, brake linings and similar products. This oil is obtained from China, where the tung-oil tree is found in its native state. A few of these trees have been grown in Florida for about a generation, but large-scale plantings did not begin until about 1923, when 14,000 trees were set out. Expansion of the domestic industry has been rapid, which is evident from the fact that in 1929 tung-oil groves covered 5,500 acres in Florida and contained 560,000 trees, and a small plant had been constructed for the recovery of the oil.

According to the U. S. Department of Commerce, tung oil in 1927 ranked fourth among the chemical products imported by this country and accounted for 6 per cent of the total. The total importation of this oil in 1927 amounted to 90,000,000 lb., valued at \$11,810,000. The increasing demand for tung oil is shown by the fact that all importations in 1913 amounted to only 45,000,000 lb.

During the spring and summer, the tung-oil tree produces its fruit, which is bright green in color and which reaches a diameter of about 2 in. During the late summer and fall, the fruit turns brown in color and finally drops from the tree. The dry fruit has a smooth hull, resembling dry leather in texture, about $\frac{1}{8}$ in. thick, and incloses several nuts or seeds. Nuts are about the size of almonds and resemble them somewhat in shape. The nut is made up of a shell, or pellicle, and a kernel. The shell is brown in color, about $\frac{1}{8}$ in. thick, hard, and brittle. The kernel, or meat, which generally fills the shell completely, is cream colored and carries 50-60 per cent oil.

The Chinese method of extracting tung oil is exceedingly primitive. The fruit is allowed to lie on the ground until the hull is sufficiently rotted to be removed easily by hand. Nuts are roasted and ground, and then the meal is pressed in a crude wooden device in which the



A Meal Made by Grinding the Kernels Is Fed Into an Anderson Expeller. The Oil Flows Out Through the Openings Between the Bars and the Hard, Dry, Fibrous Paste Is Discharged at the End

pressure is produced by means of wooden wedges, driven by hand. A dark amber color and an acid number of 4 to 10 generally are characteristics of oil produced in this manner.

As the tung-oil industry developed in the United States it became necessary to determine the best method for extraction of the oil. Since we have a well-organized vegetable-oil industry, it seemed logical that existing extraction processes could be applied with reasonable modifications to tung oil. The problem was to find machinery which would remove the hull, separate the hard shell from the kernels, crush or grind the kernels, and then remove the oil from the meal.

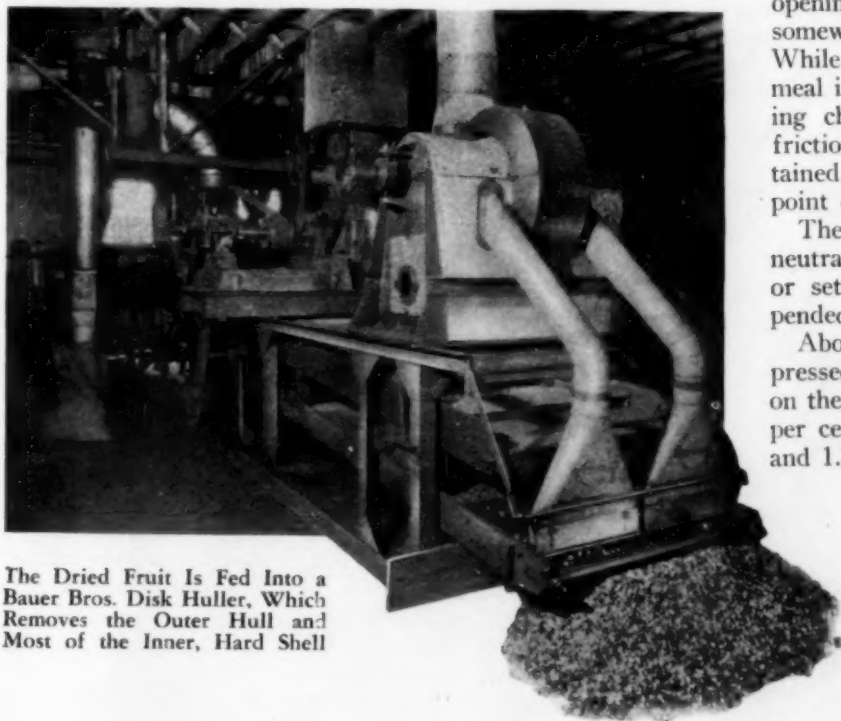
Portions of the 1928 and 1929 crops of nuts were pressed in the first scientifically constructed plant ever built for this purpose. This plant is located near Gaines-

n in Florida

ville, Fla. The principal equipment includes a Bauer Bros. disk huller, separator, grinder, and an Anderson R. B. expeller. This machinery is housed in the central portion of the plant. A well-ventilated room for drying the fruit is located at one end of the building, and three oil-storage tanks and a laboratory at the other end.

The disk huller is used in the decortication of the fruit. The whole dry fruit, which contains 47 per cent hull and 53 per cent of nut, is fed into this machine and the outer hull and most of the inner, hard shell are removed. It may be adjusted to separate all or part of the meat from the inner shell. Experiments in extraction of the oil have indicated that it is best to leave a small amount of the inner shell with the kernels. Hulls and shell are removed from the plant by the well-known principle of air separation. The capacity of the huller is about 3,000 lb. of fruit per hour, yielding 36 per cent kernels. Nuts average 63 per cent meat and 37 per cent shell.

The next step in the process is the removal of the oil, and this proved more difficult. Attempts were made to remove it in hydraulic presses, by extraction and with volatile solvents, and by the use of the Anderson expeller. While the first two methods produce more or less satisfactory results, the use of the expeller proved to be the most efficient method.



The Dried Fruit Is Fed Into a Bauer Bros. Disk Huller, Which Removes the Outer Hull and Most of the Inner, Hard Shell



—Courtesy B. F. Williamson

Dried Fruit From Tung Oil Trees in Storage Ready for Crushing

KERNELS are conveyed from the huller to an electrically operated Bauer grinding machine, where they are reduced to a meal, which is fed directly to the expeller by a mechanical conveyor. The expeller is a continuously operated machine. The meal made from the kernels is fed into this machine, and it delivers the oil and a press cake. For satisfactory operation of the expeller, the moisture in the nuts should not exceed 6 per cent. Higher moisture contents reduce the yield of oil. The removal of the oil from the meal is accomplished in the expeller by subjecting it to pressure up to about 12,000 lb. per square inch. Pressure is built up between a cylinder of chilled steel bars and a central shaft of broken screw design. The oil flows out through the fine openings between the bars, and the hard, dry, and somewhat fibrous paste is discharged at the end. While this is considered a cold-press process, the meal is preheated by steam in a jacketed tempering chamber and further heat is generated by friction during the pressing. Temperatures attained, however, are generally below the boiling point of water.

The oil is light straw colored, practically neutral in reaction, and except for filter pressing or settling to remove a small quantity of suspended matter, needs no refining.

About 5 per cent of oil is carried by the pressed cake. This cake is used as a fertilizer on the tung-oil groves, because it contains 1.7-2.7 per cent phosphoric acid, 4-6 per cent ammonia, and 1.2 per cent potash. Its value as a fertilizer has been estimated at \$35 to \$40 per ton. Recently it has been used experimentally in case-hardening of steel with gratifying results. If it is adopted for this latter use, its value will be considerably increased.

The writer desires to express his appreciation for co-operation in the preparation of this article received from B. F. Williamson and Rolf Buckley of Gainesville, Fla.

Things You Should Know

If You Own and Operate

TANK CARS

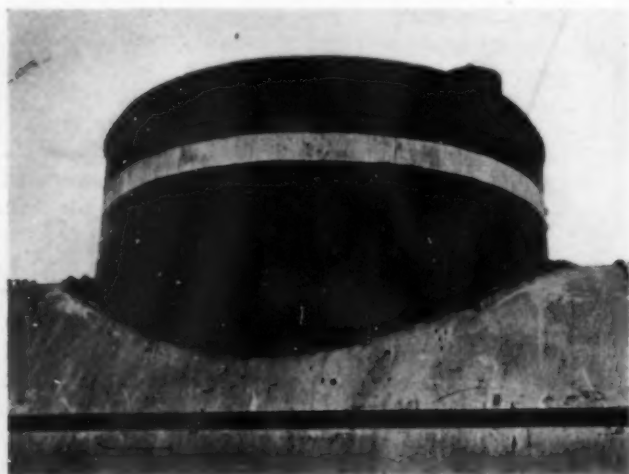
By FRED D. HARTFORD

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AFTER every possible economy of raw materials, of manufacture, and of selling has been realized, a manufacturer can often bring about further savings by a revision of shipping procedure. Especially is this true when bulk transportation can be substituted for individual packages. Bulk transportation of many chemicals means the use of railroad tank cars. Tank cars may be owned by the railroad, or they may be leased from tank-car companies, or they may be privately owned by the chemical company. This article discusses some features of tank cars which should be considered by those desiring to purchase and to maintain their own cars. But unless tank cars are properly designed in the first place both as chemical containers and as railroad rolling stock and, in addition, persistently maintained, the expected economy may never materialize.

Design of a tank car has two distinct aspects: the first, naturally, is the consideration of the tank itself as a container for certain chemicals; the second is the consideration of the entire car as a component part of the freight train. Not only must the car successfully resist the various physical and chemical actions of the liquids it contains but it must also be capable of withstanding the wear and tear incident to railroad service. As a container of dangerous liquids, its construction is subject to certain regulations of the Bureau of Explosives; furthermore, to

Metal Around the Bottom of a Tank Car Dome Is Often First to Fail on Chemical Tank Cars



insure its safe operation as a freight car, it must conform to the mechanical standards imposed by the Interstate Commerce Commission and by the American Railway Association for similar rolling stock.

Material of the Tank—The stress in a tank shell imposed by the static head of the contained liquid is negligible when compared to that produced by the inertia of the car and its contents when subjected to the impacts of freight-train operations. This fact is especially apparent when we compare the relatively fragile construction of the standard 110-gal. drum to the battleship-like proportions of the modern tank car.

AN IDEAL MATERIAL for the tank is one which combines at low cost desired structural strength with the necessary immunity to chemical action. For example, rolled steel has proved itself entirely satisfactory from economic, chemical, and structural considerations for sulphuric-acid tank-car tanks. But the degree to which iron is attacked by numerous commercial chemicals renders it totally unfit for many services, notwithstanding its excellent structural properties.

In order to utilize steel's strength and cheapness in face of its ready corrodibility, two expedients can be employed: first, the reducing of the corrosion effect on iron of the particular chemical to be transported; and second, the lining of the steel tank with a resistant coating. Two examples of the first expedient are the restriction of sulphuric acid to 60 deg. Bé. or stronger, and the combination of nitric acid with sulphuric as mixed acid; examples of the second are the rubber, glass, lead, or wood linings that have made the construction of tank-car tanks for many services economically possible. Although the use of linings must be regarded as a temporary expedient until such time as the metallurgist shall evolve a cheap alloy of suitable elastic properties for tank-car tanks, the high quality and relative cheapness of some of these linings has made the task of the metallurgist who would give us these substitute alloys formidable indeed. However, the increasing use of special alloy shells for a diversity of chemicals attests the fact that he is rising to the occasion.

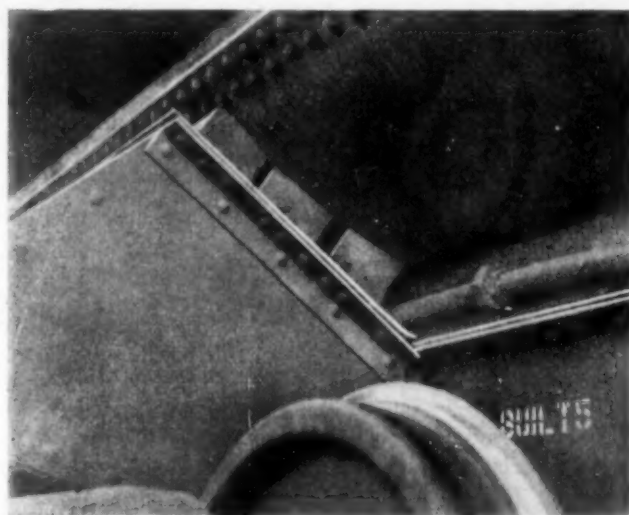
Anchoring the Tank—As previously stated, the prin-

cial stresses in a tank-car tank arise from the inertia of the car and contents when subjected to the impact of car operations. Before considering the various effects of impact on the car itself, it may be well to visualize the freight train as a whole, of which the tank car is a part. Primarily, a train is a flexible chain of which the car center sills are the links joined together at their ends by means of the couplers and draft gear. The commodity-carrying compartment may be a gondola, a box, or a tank, as the case may be. The center sill usually is combined with the carrying compartment, but in the case of most tank cars it is better to keep the sill and the compartment separate. To facilitate dragging this loaded chain rapidly from place to place, wheels and rails are added.

In the early days of railroading, the small cars and low speeds made impact a negligible factor. Today, the ever-increasing weights and power of railroad equipment and the demand for fast service create new conditions for the tank car designer to meet. It is the ideal of railroad men to handle cars with care, yet they would be the



Draft Gear Is the Only Protection of a Tank Against End Impact



Body Bolster Construction Should Give the Tank a Broad Support

last persons to deny that sometimes the demand for service, and the handicaps of obsolete locomotives, poor track, and night switching push that ideal far into the background. I have repeatedly seen muriatic tank cars in the classification yards hit so hard that acid spurted high in the air. Although such treatment may fail actually to break anything, undoubtedly it must contribute to early deterioration of the car.

End impact during car switching, certainly the most destructive force inflicted on a tank car, tends to drive the car underframe out from under the tank. End

anchorage to resist this tendency, whether rigid center anchorage, wood head blocks, or end bulkheads, must be proportioned so far beyond the point of actual rupture that no great deformation of the tank itself can occur. Fundamental factors of design of anchorage are that tank parts be reinforced if necessary to prevent denting or local failure, and that stresses be transmitted to the center sill with the least possible eccentricity.

Of little less importance than the longitudinal anchoring are the means to support the weight of the loaded tank, and the provision to protect the tank against damage from side sway. This tendency toward transverse movement results from curvature in the railroad track and from irregularities in the roadbed and is magnified by the relatively high center of gravity of the car. It is important in this connection to spread the weight of the tank over a considerable area of the bottom sheet by means of the body bolsters or cradles and to carry these bolsters well up onto the sides of the tank. Inadequate area at this point is certain to result in the cracking of the bottom sheet. In order to render body bolsters fully effective, however, the tank bands must be tight at all times to hold the tank down in position. Tank bands should be arranged so that they may be readily tightened.

Details of the Tank—At the present time steel tank-car tanks have become practically standardized with a full length bottom sheet 60 or 72 in. wide and at least $\frac{5}{8}$ in. thick, and with dished heads of the same thickness. All riveted joints except the intermediate girth seams have a double row of rivets as closely spaced as possible.

Internal corrosion of sulphuric-acid tank cars is most conspicuous at the flanged part of the tank heads and the

Although It Is Capable of Much More Gentle Hauling Than the Old Fashioned Engine, This Modern Power

Plant Has Added to the Car Designer's Difficulties; It is 121 Ft. Long and Has a Pull of 132,000 Lb.



dome shell and along the top of the girth sheets. Sometimes the rivet heads may be almost entirely eaten away, yet the adjacent sheets will be scarcely marked. It is probable that the material of the head and dome that has been most violently distorted in manufacture is most readily attacked. The rigid requirements for the hot flanging of heads in steam boiler work should be insisted upon likewise for tank-car heads and domes. The loading of very hot acid, the diluting of acid in the car, or the excessive washing of tanks may also contribute to internal corrosion. Since many of these conditions are totally beyond the control of the designer, his only recourse is to make the vulnerable parts as heavy as the customer can be persuaded to pay for.

So far as manhole fittings are concerned, it is especially commendable from the maintenance viewpoint to provide a 10- or 12-in. handhole in the manhole lid, and to flange the large manhole opening. This arrangement permits periodic remachining of the handhole cover and seat.

Capacity of the Tank—Chemical manufacturers, turning away from individual packages, generally desire to use the maximum size of tank car. Not only is the investment in a large tank car less per unit of volume than in a small one but also the unit cost of maintenance is lower. But it sometimes happens that the industries consuming the chemicals have little or no storage capacity and decline to be educated to take large-capacity cars. The number of customers, their requirements and their distances from the producing plant are also factors influencing tank car size.

A MAXIMUM size tank car may have a total loaded weight of 210,000 lb., and if the weight of the car alone be 60,000 lb., there is a permissible weight of liquid of 150,000 lb., or 75 tons. This corresponds to a volume of 18,000 gal. of a liquid which has a specific gravity of 1. However, such a volume gives a tank of inordinate size, 7 ft. diameter x 60 ft. long, too large for practical purposes. Accordingly, cars of the maximum capacity are commonly restricted to carrying oleum or other commodities of like specific gravity.

For most purposes the "100,000-lb." capacity car with a total allowable load on the rail of 169,000 lb. is the most practicable, since it is ample for any ordinary tank. In addition it possesses wearing parts of such size as to insure long trouble-free service with the least repairs.

The Car Underframe—With one exception the tank car designer need not trouble himself with the details of the car underframe, for the various parts have become standardized to a great extent. The one exception is that of the draft gear. When one realizes that all that stands between the car and destructive end impact is the draft gear, then does he fully comprehend its importance. Not only must it absorb a tremendous amount of energy within a few inches movement but also its wearing parts should be few, simple, and easily replaceable in the shop or on the repair track.

Maintenance of Tank Cars—The maintenance of tank cars usually is considered to include the repairs to the underframe and tank, the periodic tests of the tank and safety valves, and the painting and stenciling. It is sometimes extended to include the sealing up of the dome and a low-pressure air test to insure tightness of the dome fittings.

Railroads may usually be trusted to make repairs to the underframe with a fair degree of care. However, they fail to appreciate the necessity for tight tank bands; they have no knowledge of the proper methods of tank

cleaning in connection with tank repairs; they know little of the parts for loading or unloading; and, finally, their methods of painting and stenciling usually leave much to be desired. In view of this, most chemical companies owning cars do their own maintenance with the exception of wheels and axles.

When private car owners maintain their cars intelligently they find they may expect a minimum of delay due to repairs; moreover, car parts are kept standard, and there will be but few complaints from customers about defective unloading devices. In properly controlled maintenance is often found the key to the savings that bulk transportation can bring.

Life of Tank Cars—Scientists once told us that the human body is completely renewed every seven years by the replacement of old cells by new. A tank car has much the same sort of career; within seven years it too may be completely renewed. Trucks, couplers, draft gears, safety appliances, and even tank and underframe may be replaced by new at different times, making its actual life problematical. In spite of this, tank cars, like human beings, do have a definite life. A very good measure of their average life is to be found in the "Rules of Interchange" of the American Railway Association, wherein it is provided that in the case of the destruction of a tank car used for corrosive commodities a straight depreciation of 5 per cent per year is to be deducted. The life of 20 years predicated by such a depreciation rate doubtless well represents the average longevity of chemical tank cars over the country as a whole.

In individual cases, however, the life of a tank car due to local conditions may be greater or less than this average. For example, the character of the railroads over which the car is hauled has much to do with its span of usefulness. In one part of the West the 700 miles between two large cities is the equivalent of 1,600 miles of straight and level track when the work done by the locomotive is considered. Such a condition is brought about by grade and curvature in the tracks, with the result that considerable extra wear on the rolling stock is produced. But, as has been stated before, the most potent factor in decreased tank-car life is the rough treatment the cars are sometimes accorded in switching and classification. Moreover, unless a car is virtually wrecked it is almost impossible to obtain adequate redress from many railroads in spite of obvious rough handling. Fortunately, however, there are numerous railroads which appreciate the business of the private-car owner and meet him half way with respect to repairs.



New Industrial Alkali

IT HAS LONG been known that there is a group of sodium silicates of definite crystalline characteristics, as distinguished from the familiar compounds that form sirupy solutions. One of these, sodium metasilicate (Na_2SiO_3), crystallizes from solution when there is an excess of caustic, much as do other salts which separate in definite form from mother liquors. Until recently this compound has not been available commercially because there was no convenient way of producing a granular product which would not cake on standing. The Philadelphia Quartz Company has recently overcome this difficulty and is now offering metasilicate in the form of a dry powder which yields a strongly alkaline solution, said to be particularly valuable for its detergent properties in glass and metal cleaning and laundries.

Will Synthetics Completely Displace Organic Ammoniates?

"DIMINISHING supplies of organic ammoniates" has become a familiar phrase to American agricultural chemists, fertilizer manufacturers, and others interested in nitrogen as a commodity; and, on the whole, the words paint a true picture of the situation. However, like many another generality that glitters or glowers according to the position taken, there has been lacking a background of specific quantitative data to give true proportion and perspective to the view. A fundamental survey was made by E. A. Goldenweiser in 1917-18 and published in U. S. Department of Agriculture Bulletin 798; October, 1919. It showed sources and consumption of organic fertilizer nitrogen and the production of several organic ammoniates. However, the writer is not aware of the publication of similar specific data based on a survey at all comparable to Goldenweiser's, for more recent years. In view of this, and the present widespread interest in statistics relating to the supply and consumption of fertilizer nitrogen, it seems desirable to make a careful analysis of all available data in order to portray as fully as possible the present situation and apparent trends.

Only organic materials derived from natural sources are dealt with in this study; calcium cyanamide, urea, and related synthetic products considered as falling in the category of chemical carriers of "fixed" nitrogen, have been ignored.

Data have been obtained from time to time since 1923 on the quantities of animal byproducts, castor pomace, garbage-tankage, and sewage sludge used for fertilizer purposes, and recently other governmental agencies have made actual surveys yielding similar data for cottonseed meal and the production statistics for fish byproducts. In the case of a number of the commodities, however, it has been necessary to consult many sources of information and to endeavor to interpret accurately fragmentary figures from various sources in order to complete the presentation. For several of the organics there are likely to be differences of opinion as to the exact quantities produced and those used as fertilizer; on the whole, however, the data presented are believed to portray accurately the organic fertilizer situation.

It is hoped that the tabulation of these data will serve to establish a number of significant relationships not hitherto evident. For the benefit of those specialists who are interested in the sources and character of the data which have been used in arriving at the general statistics reported in Table I the writer has on file a full transcript of the method of operation followed for each entry. For the present it suffices to say that in each case the available statistics have been consulted and given as nearly as possible accurate weighting in determining production and consumption figures for the three significant fertilizer years for which data are tabulated.

A conservative estimate of the total combined nitrogen annually consumed in fertilizers in the United States

This comprehensive study indicates that we probably have reached the low point in the consumption of the natural forms of fertilizer nitrogen and that the most likely trend is upward

By G. P. WALTON

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Washington, D. C.*

is 325,000 tons, including both organic and inorganic nitrogen. Probably 350,000 tons is closer to the total for the year 1929. Of this quantity approximately one-sixth (55,000 to 60,000 tons of contained nitrogen) is derived from organic sources, chiefly from byproducts or residues from the manufacture of fats and oils. About two-thirds of this organic fertilizer nitrogen is obtained from industrial byproducts produced in this country; more than 5,000 tons is nitrogen salvaged during the sanitary disposal of the organic wastes of large cities; only about 1,200 tons ordinarily is obtained from our natural deposits, peat. Imports account for 10,000 to 12,000 tons of nitrogen as "guanos" and miscellaneous nitrogenous materials, which are chiefly fish scrap from northern Europe and tankages from there and South America.

Nearly one-half of the organic nitrogen consumed in fertilizer is furnished by the four long-favored organic ammoniates: Animal tankage, dried blood, cottonseed meal, and fish scrap. But ever-increasing quantities of these commodities are being diverted from the fertilizer market to more advantageous disposal as feeding stuffs for livestock. At times, it is true, temporary reversals in this general trend may be noted, but on the whole, the procuring of adequate supplies of these materials at prices not prohibitive for the fertilizer trade is becoming a bigger problem every year. On the other hand, other valued ammoniates, such as castor pomace, which cannot be used as an animal feed, are obtainable in as large or even larger quantities.

MOST of the organic materials going into mixed fertilizers, contributing over 90 per cent of the organic nitrogen in such goods, are used by the manufacturers as sources of plant-nourishing nitrogen which may be credited in the guaranteed analysis of the commercial mixtures. Some garbage tankage, dried peat, cocoa shells, and similar material is used primarily as a conditioner, or moisture-absorbing filler, for the purpose of improving the physical or "mechanical" condition of the mixed fertilizer. The function of such conditioners is to prevent caking on the one hand or the development of tackiness on the other, and above all, to insure satisfactory drillability of the fertilizer in the field. Several of the high-grade ammoniates used primarily for their

organic nitrogen, such as castor pomace and cottonseed meal, also are valued for their conditioning properties.

An attempt has been made to present in Table II the more significant relationships existing among the data pertaining to fertilizer nitrogen, and more particularly to the organic nitrogen. Table II also includes relationships indicating the trends in the consumption of organic fertilizer nitrogen.

In the case of the commercial mixed fertilizers, it is of interest that the content of organic nitrogen now amounts to only 0.7 per cent, or about 20 per cent of their total nitrogen, whereas in 1917-18, according to Goldenweiser's data, such goods contained approximately 1.51 per cent of organic nitrogen, comprising about 51 per cent of their total nitrogen content. It is estimated that in addition to the 44,000-odd tons of organic nitrogen now used in commercial mixed fertilizers, about 11,000 tons is contained in organic materials that are used alone or in home-mixed fertilizers.

The increase in the inorganic nitrogen, amounting to at least 113,000 tons, is in large part traceable to fixed atmospheric nitrogen contained in ammonia and other chemical compounds manufactured from the nitrogen of the air.

Some of the trends affecting future supplies of the important nitrogen carriers of an organic type deserve

special consideration. A number of factors affecting such trends are discussed in the following paragraphs.

Animal Tankage—The increasing use of animal by-products and cottonseed meal as feeding stuffs instead of as fertilizer materials, noted before this country entered the World War, became decidedly marked in the years immediately following its close. With the development of the dry-rendering process in 1922-23 and its application to the manufacture of animal fats and oils from animal offal, a tremendous impetus was given the movement of animal "tankages" into the feed market. The cracklings-like product obtained by the dry-rendering of animal tissues possesses such desirable properties for feeding purposes that from the first practically all produced has been marketed as stock food. And, even in the case of the direct-steam rendered product, "digester tankage," improvements in the technique of handling the animal wastes have resulted in diverting an ever-increasing share of this material from the fertilizer into the feeding stuffs market.

Cottonseed Meal—This product continues to furnish more of the organic nitrogen consumed in fertilizers in the United States than any other ammoniate. In spite of the fact that more than three-fourths of the entire quantity produced in this country last year was used in the feeding of livestock, cottonseed meal remains

Table I—Organic Nitrogen and Its Carriers Consumed as Fertilizer in the United States in One Year

Material	Nitrogen Content, Approx. Average Per Cent	1917-18 One-Year Period; Chiefly Based on Average of Goldenweiser's Data for the Two Years ⁸			Intermediate One-Year Period for Comparison			Latest One-Year Period for Which Data Are Available			
		Quantity of Mate- rial Consumed as Fertilizer, 2,000- Lb. Tons	Percentage of Total (or Importation) Per Cent	Quantity of Pure Nitrogen Con- sumed as Fertil- izer, 2,000-Lb. Tons	Year	Quantity of Mate- rial Consumed as Fertilizer, 2,000 Lb. Tons	Percentage of Total (or Importation) Per Cent	Year	Quantity of Mate- rial Consumed as Fertilizer, 2,000 Lb. Tons	Percentage of Total (or Importation) Per Cent	Quantity of Pure Nitrogen Con- sumed as Fertilizer 2,000-Lb. Tons.
Animal tankages ²	8.90	255,460 ⁴	64.5	22,736	1925-26	62,500	17.9	1927	61,800	17.9	5,500
Dried blood	13.00	31,490 ⁴	83.6	4,094	1925-26	4,100	7.5	1927	4,000	7.5	520
Castor pomace	3.00	28,215 ⁴	100.0	1,411	1926	28,500	100.0	1929	45,000	100.0	2,250
Cocoa shells and other cocoa byproducts	3.00 ⁵	9,400 ⁴	50.0	282	1924	16,000	36.5	1929	13,000	50.0	390
Cottonseed meal	6.17	721,700 ⁴	34.9	44,529	1926-27	444,200	15.6	1928-29	183,300 ¹⁰	8.0	11,310
Fish scraps ⁶	8.64	40,634 ⁴	100.0	3,511	1925	58,200	59.5	1929	43,205	33.0	3,733
Garbage tankage	2.75	163,500 ⁴	100.0	4,496	1924-1926	133,000	95.0	1927-28	110,000	91.7	3,025
Hoof and horn meal	12.50	6,148 ⁴	88.3	756	1925-26	5,615	88.3	1927	5,610	88.3	690
Peat, dried	2.00	85,918 ⁴	84.0	1,718	1924	55,196	99.5	1926	61,600	99.5	1,232
Sewage sludge, activated, dried	5.60			41 ⁷	1927	19,850	100.0	1929	37,000	100.0	2,072
Miscellaneous base goods, including proprietary tankages; acidulated leather, hair, etc.; and other nitrogen- ous materials	{ 2.5 ⁸ 8.6 ⁸	541,550	99.0	13,539	1926	100,000 ⁹	100.0	1929	80,000 ⁹	100.0	2,000
					1926	120,000 ¹⁰	100.0	1929	126,000 ¹⁰	100.0	10,836
Total		1,884,015		97,113		1,047,161			770,515		43,558
Deduction to correct for duplication of material included in base goods: equivalent to garbage tankage	2.75	25,513	100.0	702							
Domestic Material	5.19 (5.65) ¹¹	1,858,502		96,411		1,047,161			770,515		43,558
IMPORTED MATERIALS ¹²											
Animal tankages	8.90				1925	8,417	25.0	1929	5,818	25.0	518
Dried blood	13.00				1925	856	7.5	1929	821	7.5	107
Guano, Peruvian	12.60	{ 60,132 ¹⁴	100.0	3,860	1925-26	8,899	100.0	1929	13,403	100.0	1,689
Guano, so-called, chiefly fish fertilizers	8.64				1925	13,448 ¹⁵	100.0	1929	38,010 ¹⁶	100.0	3,284
Nitrogenous fertilizer materials not else- where specified ¹⁷	{ 8.50 (5.02)	(34,211) ¹⁸	100.0	1,717	1925	81,527	100.0	1929	77,324	100.0	6,573
Imported Material		94,343 ¹⁹		5,577 ¹⁹	1925-26	113,147		1929	135,376		12,171
Total—Consumed as organic fertilizer		1,952,845		101,988		1,160,308			905,891		55,729

1. Detailed explanation of the sources of the data here presented, and the methods of computation employed for data obtained indirectly, have had to be omitted for lack of space, but full details can be obtained through the Bureau of Chemistry and Soils.

2. Goldenweiser's tables I and VI refer only to "mixed fertilizers," but for several materials the quantity used straight and the total production are stated in the text, and have been used in connection with the data in this column. The figures for cocoa shells and peat are not Goldenweiser's.

3. All grades of animal tankage, including so-called "concentrated tankage" or dried "stick liquor" and an appreciable quantity of admixed blood, but no "cracklings" are included in this item. The nitrogen content of 8.9 per cent is the weighted average.

4. This quantity is greater than that corresponding to the percentage of the total domestic production reported as used for fertilizer, and undoubtedly includes imported material so used.

5. The nitrogen content of commercial cocoa shells is usually between 2.5 and 3 per cent; that of byproduct press-cake is 3.5 to 4.5 per cent.

6. Includes green and acidulated scraps (calculated to the equivalent in dry scrap) and small quantities of whale tankages and shell-fish wastes.

7. The quantity of activated sludge used as fertilizer in this period was negligible, the first large installation (Houston, Texas) was not in operation until 1917. About 2,500 tons of low-grade dried sludge was marketed for fertilizer purposes.

8. Two and five-tenths per cent is the weighted average nitrogen content of the base goods, hair, hide scrap, leather, wool waste and miscellaneous tankage reported by Goldenweiser for 1917 and 1918. In recent years large quantities of the crude organics have been processed to make proprietary tankages, the average nitrogen content of which is about 8.6 per cent.

9. Old-style, wet-mix base goods; rough estimate.

10. Acidulated or otherwise processed and dried, nitrogenous materials and proprietary tankages, accounting for the remainder of the total "base goods" nitrogen less the duplication of nitrogen from garbage tankage, etc., used in base goods.

11. Average nitrogen content for the 1929 period.

12. The data other than for 1917-18 for imported materials have been taken from reports of the U. S. Bureau of Foreign and Domestic Commerce and recalculated to the equivalents in short tons.

13. The greater part, if not all of the fertilizer tankage and blood imported for this period is undoubtedly accounted for by the figures for these com-

modities given above in the domestic materials section of the table.

14. This quantity represents material reported by Goldenweiser as "Natural Guano," with an average nitrogen content of 8.42 per cent.

15. Includes 1,067 long tons of probably cave guano from Cuba and Mexico.

16. Includes 803 long tons of probably cave guano from Mexico and 3,022 long tons so-called guano from the Argentine.

17. Includes imported castor pomace, hoof meal, some fish scrap and probably processed leather and other proprietary so-called tankages.

18. This quantity is the average of Goldenweiser's figures for "Other Nitrogenous Material," with an average nitrogen content of 5.92 per cent and is not necessarily all imported material. There may be some slight duplication of quantities in this item in case it includes cocoa shell meal used as conditioner in mixed fertilizers.

19. Incomplete: Some imported material was included with several of the items for domestic materials.

20. Partly revised; subject to further revision in the department.



Fig. 1—Cottonseed Meal: Domestic Production and Consumption as Fertilizer

our most important organic ammoniate fertilizer. There has been a marked trend, however, toward increased use of it as feed, with corresponding decreased use as fertilizer, as shown by a comparison of the records of 1917-18, when approximately 35 per cent of the total production was consumed as fertilizer, with the figures for 1928-29, when fertilizers took only 8 per cent. That the recent decrease in the use of cottonseed meal for fertilizer is not at all uniform is shown by the curves in Fig. 1, particularly the fragmentary curve for the quantities consumed. In years of heavy production, when the selling price is low, not only is a greater tonnage of the meal used as fertilizer but even a larger share of the total produced is so used. Because of the supply right at hand, reducing freight charges to a minimum, Southern farmers doubtless will continue for many years to use large quantities of cottonseed meal as fertilizer material.

Fish Scraps—The curves shown in Fig. 2 indicate a steady increase in the production of fish meal for feeding purposes rather than of scrap for fertilizer. As in the case of the manufacture of animal byproducts, improvements in factory practices have made a larger share of the product more suitable for feeding purposes than formerly. Much of the credit for the increased production of higher grade fish meals is due the U. S. Bureau of Fisheries, which for several years has been conducting researches into practical ways of improving the quality of the scrap or residue from the manufacture of fish oils.

Garbage Tankage—The outlook with respect to the future utilization of garbage tankage for fertilizer purposes is not easily analyzed. There appear to be at

least three comparatively new factors in the situation worthy of consideration:

First, the steadily decreasing price for fertilizer nitrogen, a result of the tremendous advance in the fixation of atmospheric nitrogen, may be expected to dull the market for organic ammoniates and such materials as garbage tankage for fertilizer purposes. There is, however, the possibility—even the likelihood—that an abundance of cheap nitrates, by furthering the total consumption of fertilizer, may as a consequence ultimately increase the consumption of organic fertilizer conditioners and fillers, including garbage tankage.

Second, the ever decreasing supply of farmyard manure, especially in the vicinity of large cities, is constantly accentuating the demand for substitutes which can be used by truck growers, home gardeners, or florists, and this would appear to offer an opportunity for marketing increasing quantities of properly extracted garbage residues, particularly in the undried condition. In fact, thousands of tons of garbage tankage were used in a single year recently near two of our large cities as a sort of makeshift substitute for manure. Of course, such utilization, or the reduction of garbage by fermentation (as in the Beccari process by which raw garbage is reduced to a humus-like product), tends to diminish the supply of the dried garbage tankage used in the mixed fertilizer industry.

Third, the recent development and operation by at least two cities of processes for the manipulation of partly degreased garbage tankage, whereby over 50 per cent of the dry tankage is separated as a fine meal said to be suitable for use as hog or poultry feed, holds out at least the possibility for a wider field of usefulness in agriculture for well extracted garbage residues.

All three of these considerations offer possibilities tending to promote utilization of municipal garbage, as opposed to destruction by incineration or other means; but only the first could have a favorable effect on the production of the commercial dried garbage tankage.

Peat—After the great boom in the production of peat for fertilizer purposes which occurred during the war period in this country, the quantity used in connection with fertilization fell back from the 1917 high mark of

Table II—Some Salient Figures on Organic Ammoniates and Fertilizer Nitrogen in the United States

ONE-YEAR PERIOD		1917-18	1929
Organic (commercial) materials consumed as fertilizer:			
Total quantity.....	Short tons	1,952,000	906,000
Produced in United States:			
Quantity.....	Short tons	1,858,500	770,500
Per cent of total.....		95	85
Nitrogen content.....	Per cent	5.2	5.7
Quantity of nitrogen.....	Short tons	96,400	43,600
Cottonseed meal.....	Short tons	721,700	183,300
Animal byproducts, including imports.....	Short tons	287,000	72,000
Fish scraps, including imports.....	Short tons	.....	81,000
Total nitrogen contained in all commercial fertilizers consumed.....	Short tons	190,000	350,000
Organic nitrogen in all such fertilizers:			
Quantity.....	Short tons	102,000	56,000
Per cent of total nitrogen.....		54	16
Commercial mixed fertilizers consumed:			
Quantity mixed goods.....	Short tons	4,700,000	6,000,000
Contained nitrogen (total):			
Quantity.....	Short tons	138,400	225,000
Per cent of goods.....		2.95	3.5 to 4.0
Contained organic nitrogen:			
Quantity.....	Short tons	71,000	45,000
Per cent of goods.....		1.51	0.70
Approx. per cent of total nitrogen.....		51	17.5 to 20.
Decrease since 1917-18 in consumption of:			
Organic (commercial) fertilizer materials:			
Produced in United States.....	Per cent	.....	58.5
All.....	Per cent	.....	53.6
Organic fertilizer nitrogen:			
In goods produced in U. S.....	Per cent	.....	54.8
In all goods.....	Per cent	.....	45.4

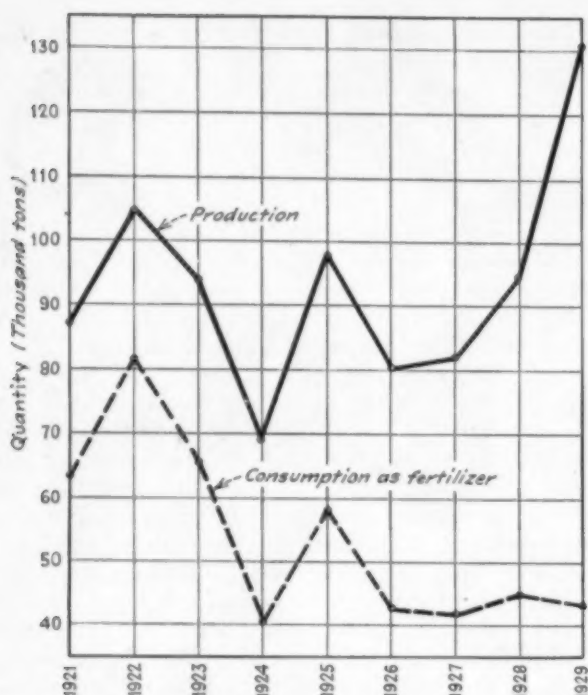


Fig. 2—Fish Scraps and Meal (Domestic): Production and Consumption as Fertilizer (on basis of Dry Scrap)

over 92,000 tons to the normal 50,000 or 60,000 tons so used. The trend is shown graphically in Fig. 3.

The ordinary dried peat of commerce has low value as fertilizer, and is not to be compared with stable manure or with mineral fertilizers as an agent for increasing crop production. As a conditioner as well as a filler for mixed fertilizers, peat appears to be satisfactory. Although peat ordinarily contains little available plant food, considerable quantities of it are used by florists, gardeners, and greens keepers for mulching and composting purposes and as a soil amending organic material.

Sewage Sludge—The outlook for a progressive increase in the production of commercial activated sewage sludge appears favorable. The city of Milwaukee has shown the way to the successful production from municipal sewage of an organic fertilizer material of real value. Not only does activated sludge contain two to three times as much nitrogen as the older types of sewage sludge produced by plain sedimentation, or by sedimentation and anaerobic digestion, but the nitrogen is in forms more available to growing plants. As a result there is a ready market for dried activated sludge, whereas in the past the drying of other types of municipal sewage sludge has not generally paid.

Base Goods—The production of wet or acid mix "base goods" has fallen off since the World War to a fraction of the prior figure. The "crude ammoniates," such as hair and scrap leather, that formerly supplied the organic nitrogen for these goods are now largely used in the preparation of proprietary nitrogenous "tankages" which, in the end, serve much the same purpose as the old-style base goods. On the whole, the quantity of nitrogen going into fertilizers in goods of this general class probably is every whit as great as it ever was; and there is no apparent reason for expecting any marked change in the near future.

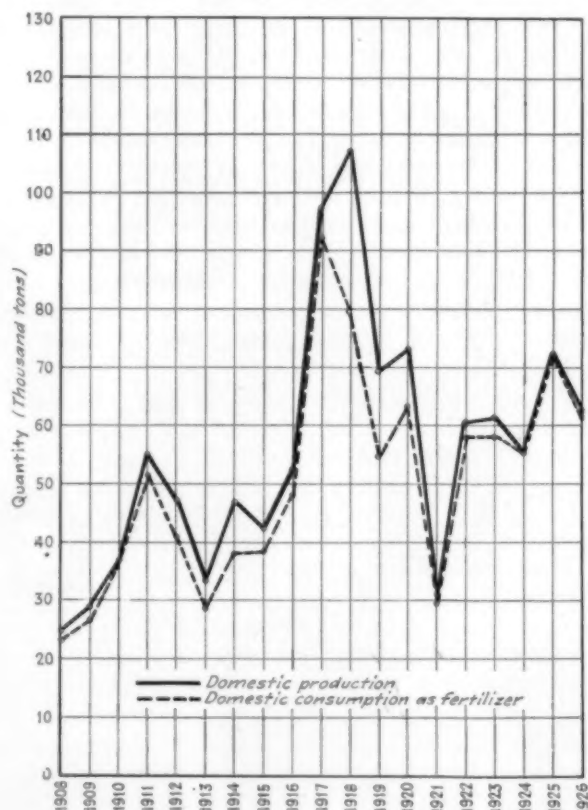
Imported Materials—The importation of organic nitrogenous fertilizer materials appears to be on the

increase. In the case of Peruvian guano, more was brought into this country in 1929 than in any one year since 1915.

SUMMARIZING, the present study, which has dealt only with commercial organic fertilizer materials derived from natural sources, it has been shown that in this country there has been a great progressive decrease since the World War in the consumption of organic nitrogen in commercial fertilizers. This decline in the use of organics has fallen almost wholly on four of the five most highly valued organic ammoniates: animal tankage, dried blood, cottonseed meal, and fish scraps. Because of their mounting popularity as feeding stuffs the indications are that before many years have passed only such portions of these materials as are unfit for use as stock food will be available for fertilizer purposes. In the case of the fifth long-favored ammoniate—castor pomace—there has been some increase in the quantity used as fertilizer.

It is within the realm of possibility, however, that we are nearing the low point in the consumption of organic nitrogen in commercial fertilizers, and that the future may bring an upturn in the trend. An increased production of fertilizer from municipal sewage; the salvaging of large quantities of fish offal now wasted, by chemical treatments yielding products unfit for use as feed but suitable for fertilizer; increased utilization of municipal garbage for agricultural purposes; increased production of nitrogenous "tankages" from additional crude ammoniates and waste materials; even the tapping of our almost inexhaustible supplies of peat for the preparation of organic fertilizers, are some of the possibilities which may materialize in the future to compensate for the decreasing use of the standard organic ammoniates.

Fig. 3—Peat: Domestic Production and Consumption as Fertilizer Material



FERMENTATION

As a Manufacturing Process

FUNDAMENTALLY, but little is known about the nature and control of one of the most important and productive of chemical reactions: fermentation. With a view to giving its members some idea of the broad field of fermentation in industry, as well as the many complications and difficulties involved, the American Chemical Society devoted one of its general sessions at Cincinnati on Sept. 8 to a symposium on Industrial Fermentation.

Fermentation reactions are essentially catalytic, according to Prof. E. I. Fulmer, of Iowa State College. The catalyst is produced by a living organism during the course of the reaction which takes place either in the cell of the organism or in the fermenting medium. In the latter case the catalyst, or enzyme, as it is more generally called, is discharged into the solution and induces a reaction there. Any given organism may produce a number of different catalysts, depending on the food which is supplied to it and the condition under which it works, while it is also true that the same finished product may be produced from a number of different raw materials.

Chronologically, the first fermentation process to become known to humanity probably was the production of ethyl alcohol. Dr. Arthur A. Backhaus, vice-president in charge of production of the U. S. Industrial Alcohol Company, stated that from an industrial standpoint, the most important aspects of the ethyl alcohol fermentation is the production of this material for denaturing and subsequent use in industry. Although the industry in this form has existed in the United States only during the past 25 years, the production of denatured alcohol has increased in that time from 2,000,000 wine gallons in 1907 to 107,000,000 gal. in 1929.

As its name implies, lactic acid was first obtained from milk, but as an industrial product, it, too, is generally produced from molasses. J. A. Garrett, of the Grasselli Chemical Company, told how a solution of this material is inoculated with the proper lactic-acid bacillus and the reaction allowed to go to completion. Because of the sensitiveness of lactic-acid bacteria to an excess of acid, it is necessary to neutralize the fermentation with limestone while it is in progress. Lactic acid is used chiefly in the deliming of hides after the dehairing process. It is also used in the dyeing and finishing of textiles, the production of lacquer solvents and, when properly purified, for food and beverage purposes.

Dr. Charles N. Frey, of the Fleischmann Laboratories, dealt with the broad subject of yeast production and its use in the manufacture of bread. The paper on "Butyl Acetonic Fermentation," by C. L. Gabriel and F. M. Crawford, of the Commercial Solvents Corporation, was the first to deal with the more modern application of fermentation principles in industry. This fermentation was first developed in England for the production of butadiene (from butyl alcohol) to be used in the synthesis of rubber. With the advent of the war, interest in this fermentation shifted from butyl alcohol to acetone, sorely needed for the manufacture of cordite and airplane dope. At the end of the war, the pendulum swung again, and the demand for butyl alcohol as a solvent in the lacquer industry centered attention once more

upon this product. The butyl-acetonic fermentation is carried out by the inoculation of a mash of starch from corn or other starch-containing material. Forty-eight to 72 hours is required. Butanol, acetone, and ethyl alcohol, produced in the ratio of approximately 6:3:1, are recovered by distillation from the fermented material.

According to Dr. F. C. Blanck, in charge of Food Research in the Bureau of Chemistry and Soils, our American food industries represent a total production



Horace Terhune Herrick
Principal Chemist, Color and Farm Wastes Division, U. S. Bureau of Chemistry and Soils, served as secretary in arranging the program



Bruce Keith Brown
Patent Attorney, Standard Oil Company of Indiana and former Commercial Solvents advisor, presided as chairman of A.C.S. symposium

value of more than ten billion dollars. In this total production, fermentation processes play an important part in the manufacture of yeast, bread, cheese, cocoa and chocolate, some cured meats, and fish, sauerkraut, pickles, vinegar, and olives. While it may be generally understood that micro-organisms play a large part in the production of many of our important foods, it probably is not known that bacteria may now be utilized to produce the gas by which the food is cooked. Prof. A. M. Buswell, director of the Illinois State Water Survey, traced the history of the decomposition of organic matter by bacteria and the potential utilization of the methane so produced as a fuel. The author made the prediction that with the exhaustion of present fuel supplies, fermenting farm waste may replace natural gas as a source of gas for the farm.

The final paper, "Some Minor Industrial Fermentations," was presented by O. E. May and H. T. Herrick, of the Bureau of Chemistry and Soils. The term "minor" was not used to characterize the chemical importance of these fermentations but rather alluded to the fact that the production of the materials described was not as large as in the case of some of the better known fermentations. The authors discussed the manufacture of citric acid, gluconic acid, gallic acid, and glycerine by fermentation methods. Citric acid is now manufactured by the action of molds on cane sugar. The production of millions of pounds annually by this process has rendered this country independent of the Italian supply of crude citrate of lime. Gluconic acid, also produced by molds, but with corn sugar as the base, is one of our newest fermentation products. It is only recently that this material has gone from the position of a laboratory curiosity to a technical product. Gallic acid, also produced industrially by the action of molds on a solution of tannin, is a product of wide commercial importance.

New Vapor-Phase Cracking Process For High-Compression Fuel

By **NORMAN W. KRASE**

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CERTAIN crude oils, when processed according to modern refinery practice, yield distillate fuels satisfactory for present-day high-compression motors. Such oils, however, are of limited occurrence and entirely unable to meet the tremendous production of quality motor fuel. The present solution lies in the addition of anti-knock materials to ordinary gasoline. An attractive goal for the refiner, therefore is the development of a refining process that will yield high-quality gasoline directly. The record of attempts to modify and improve existing cracking operations is long and interesting. Vapor-phase cracking operations are receiving a large share of attention, and of these one of the most recent and important is the Pratt process, owned by the Automotive Distillate Corporation of St. Louis, with fabricating and sales rights vested in the J. P. Devine Manufacturing Company at Mount Vernon, Ill. A semi-commercial unit processing about 300 bbl. per day is now in operation at the plant of the Lubrite Refining Company at East St. Louis.

The Pratt process, described in U. S. Patent 1,752,264, is designed to yield a blending fluid of extremely high anti-knock properties. As regularly produced, gasoline from the Pratt process has anti-knock properties best expressed as "85 per cent benzol equivalent" and can profitably be mixed with equal volumes of skimmed

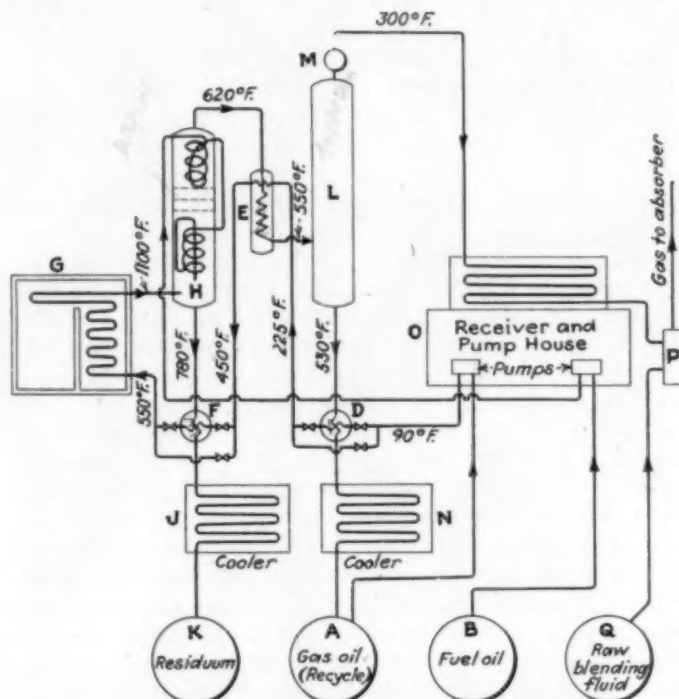
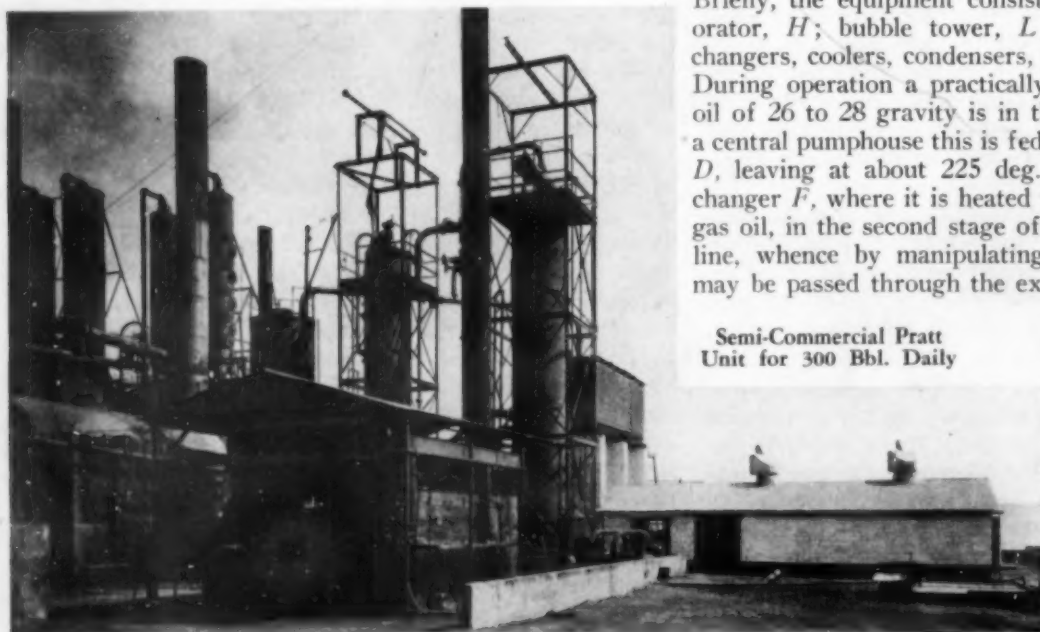


Fig. 1—Flow Diagram of Pratt Vapor Phase Cracking Process

gasoline to make a finished fuel of approximately 40 per cent benzol equivalent. Operation of this process in connection with skimming or other methods that at present yield ordinary gasoline enables the refiner to produce high-compression fuel directly.

The accompanying flow diagram, Fig. 1, is a description of the new cracking process, showing necessary units and average operating temperatures at every point. Briefly, the equipment consists of a furnace, *G*; evaporator, *H*; bubble tower, *L*; together with heat exchangers, coolers, condensers, pumps, and storage tanks. During operation a practically constant quantity of gas oil of 26 to 28 gravity is in the supply tank, *A*. From a central pumphouse this is fed through a heat exchanger, *D*, leaving at about 225 deg. F., and through the exchanger *F*, where it is heated to about 450 deg. F. The gas oil, in the second stage of preheat, passes through a line, whence by manipulating valves, any or all of it may be passed through the exchanger *F*, where its temperature reaches 550 deg. F. A similar arrangement of valves controls temperatures at *D*. The preheated oil now enters the heating coils of the furnace, *G*. An interesting feature is that the oil travels through the furnace in a stream of small cross-section and



Semi-Commercial Pratt
Unit for 300 Bbl. Daily

Product	Test No.	Color	Doctor	Grav.	Initial	Temperature—Deg. F.										End Temp.	Remarks
						10	20	30	40	50	60	70	80	90	%		
Gas Oil.....	1	Dark	...	33.0	384	443	463	478	494	513	532	558	601	662	96.5	722	Cross P. D. Bottoms. Charging Stock
Vapor Phase.....	2	Amber	...	49.4	100	180	230	273	319	353	375	390	404	417	97.0	432	
60-40 Blend.....	3	Y	...	54.5	103	178	213	243	273	300	328	354	376	400	97.0	423	Not blend. No absorption used
Gasoline.....	4	25	Pos.	56.8	130	180	206	227	247	267	289	311	332	362	98.0	411	
Compression Gasoline.....	5	Y	Pos.	74.2	70	109	124	139	152	163	181	209	239	...	91.0	324	St. Run Gas
Gasoline.....	6	25	Pos.	60.3	127	177	205	223	240	254	270	289	307	335	98	389	
Gas Oil.....	7	...	...	24.2	448	474	484	494	502	509	518	534	556	602	98	686	B.S. & W 0.8
Residuum.....	8	Black	...	12.3	Flash-275	Fire-315 C.T.O. (Vis. at 122.—21) Furoie										...	

leaves completely vaporized with practically no formation of coke. The lower, or convection heading, section of the coil is made of low-carbon steel boiler tubes and the top, or high-temperature radiant, section is made of high-chrome nickel alloy. The oil vapors reach a temperature in the order of 1,100 deg. F. and discharge into the bottom of the evaporator, *H*. Leaving this stream for the moment, it is best to follow another concurrent operation. Tank *B* contains fuel oil of 24-26 gravity which is normally supplied from the refinery as a product of the skimming operation which removes gasoline and kerosene fractions from crude oil. The following description applies specifically to an operation where Mid-Continent pipe-line crude oil is skimmed. Fuel oil is pumped from *B* to a combination refluxing and pre-heating coil located at a point near the top of the evaporator *H*. The oil is thereby preheated to approximately 550 deg. F. and then discharges into the evaporator near the bottom, where it comes into intimate contact with the vaporized gas oil from the furnace, which enters at 1,100 deg. F. At this point the fuel oil is distilled and partly cracked by the gas oil vapors, producing cracked gasoline and a gas oil charging stock from the fuel oil. Also the comparatively low-temperature fuel oil condenses a portion of high-temperature gas oil vapors. These heavier fractions collect in the bottom of the evaporation and pass through the preheater *F* and a cooler, *J*, to the residuum storage tank *K*.

Vapors leaving the evaporator at about 620 deg. F. pass through the heat exchanger *E* to the bubble tower *L*, which they enter at 550 deg. F. The reflux condenser, *M*, at the top is regulated to pass the product at 300 deg. F., which in turn condenses to a gasoline-

like liquid having an end point of 425 deg. F. The fraction drawn off the bottom of the tower at about 530 deg. F. passes through exchanger *D* and cooler *N* to the gas oil storage tank *A*. It can readily be seen that the condensate in the bottom of *L* is composed of a certain portion of gas oil which has passed through the furnace coil and corresponds to what is known as "recycle" gas oil. During the operating period the quantity of this oil in tank *A* does not change appreciably.

The vapors leaving the reflux condenser, *M*, are condensed in *O* and enter the gas separator, *P*. The liquid goes to a raw blending fluid storage tank, *Q*, and the gas to the absorber (not shown), where it is stripped of light vapors.

The table above, from the plant record book, gives essential data on blending fluid produced, on the gas oil and residuum, blending stock and finished product.

Of particular interest to chemical engineers in the oil industry is the fact that this development is another of a considerable list of recent achievements that depend fundamentally on the utilization of high-temperature alloys. At 1,100 to 1,200 deg. F. and under severe corrosive conditions, furnace coils of exceptional properties are required. During a recent run of 15 days no evidence of corrosion or coke formation appeared and it seems likely that a normal operating cycle of 30 days will be possible. This is an achievement of great importance and a considerable advance over present vapor-phase operations.

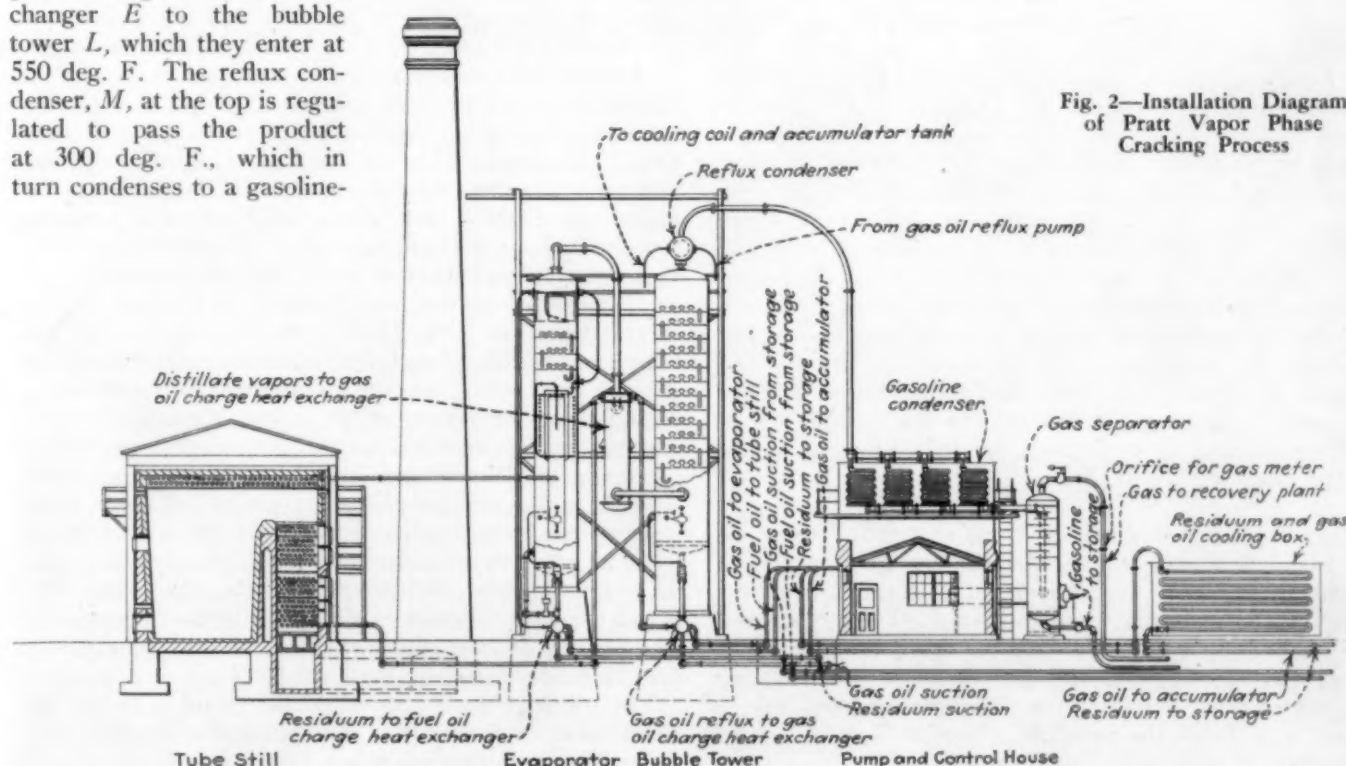


Fig. 2—Installation Diagram of Pratt Vapor Phase Cracking Process

CARTEL-ized COMPETITION

Editor's Note — Here an eminent patent attorney, economist, and industrial advisor outlines the strong and weak points in this more aggressive competition and then shows the practical steps a domestic industry should take in order to protect itself from the international cartel.

What Does It Mean For American Industry?

By H. A. TOULMIN, JR.,

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IS CHEMICAL INDUSTRY genuinely affected by cartelization? Just now this is a critical competitive question. Within the last month we have witnessed the synthetic and natural nitrate industries fusing their interests in the formation of a huge world cartel. Rayon, potash, aluminum, borax, copper, lead, zinc, steel, plate glass, and carbide have all been the subjects of international negotiations and agreements in recent years. Accelerated by overproduction and declining commodity prices, the European pendulum of events has swung from war hostility to close economic partnerships. What does it mean for American industry?

Internationally minded chemical industries may be protected at home from unfair competition, but abroad various chemical cartels formed by nationals from each of the co-operating foreign countries can readily attack the flanks of our business. This foreign competition in the chemical fields is two-phased. First, there is the direct sales competition from the cartels in foreign markets. Second, there is the domestic competition with the cartel owned patent monopolies under which competitors may be licensed in the United States. Thus cartel competition may be carried right into the United States itself.

Nowhere is this competitive situation keener than in the chemical field, because the products of its industries lend themselves particularly well to cartelization. Where, as in the chemical field, we have vast quantities of standardized materials that need merchandising of world-wide scope, there we find the cartels most active. Again, wherever chemical products are susceptible of being sold through a common sales organization, such as rayon and nitrates, or where there are patented chemical products of general application, we are likely to have two serious factors in competition: cartelization and interlocking patent licenses. The joint sales organization and the cross-licensing arrangements are the dual factors of cartel supremacy; in some cases we only find one and in other cases we find both.

JUST what is this foreign form of fighting unit? A cartel is a central sales department for a group of competitors whose products are of such uniform nature they can be sold from a common pool. The parties to it are bound by contract to deliver their production, to limit their production, and are penalized for violating the agreement. In fact, many governments will take a hand to enforce the penalties. German law is a good example of government enforcement.

In the United States we have tried the scheme. It has always failed. The reason was that we had no means of enforcing the gentleman's agreement as it was illegal under our laws. We tried pools and voting trusts; they failed. We tried mergers; but even mergers are running into legal difficulties, as witness the Standard Oil of New York and Vacuum merger or some similar efforts in the moving-picture industry.

In Germany, on the contrary, a complete inspection system by state inspectors looks after the warehouse stocks, books of accounts, and correspondence of the cartels members. Penalties for violation of the cartel terms may take the form of fines for every ton delivered by the manufacturer in excess of the allotted production.

Of course, the background in Europe, and particularly Germany, is especially good for the formation of chemical cartels. Commencing in 1904, the dye trust, composed of the I. G. Farbenindustrie A. G., constituted the first real cartel of its kind. By this organization heavy chemicals of the Badische company and the production of intermediates and dyes were joined to other producers in similar fields and also in the pharmaceutical branch. Heavy chemicals were the balance wheel to the synthetic organic industry, and economies in purchases and sales and in distribution of gross, semi-manufactured products and foreign materials resulted. By 1916 there was added Griesheim-Elektron and Weiler-ter-Meer, and nitrogen fixation became the critical issue. Eventually in 1925 there was formed the real I. G. Farbenindustrie, A. G. In 1926 this combine, the greatest in Europe, had a capitalization of 1,100,000,000 marks. The Union for Chemical and Metallurgical Production extended out of Austria into Czechoslovakia, controlling heavy chemicals, organics, and fertilizers. Over in Italy the Italian chemical combine represented by the Montecatini consolidations controlled fertilizers, organics, alkalis, and nitrogen with three dozen super-phosphate plants and seven fixation plants. Starting in 1825, the Kuhlmann interest in France had developed a long line of heavy chemicals, dyes, intermediates, fertilizers, and the like. The Imperial Chemical Industries of Great Britain constitutes an affiliation of important producers of heavy chemicals, dyes, fertilizers, and nitrogen products.

The prime economic object of the cartel is to control competition. To do this it must control overproduction and permit lowering of prices in the home market; it

must dump its excess products abroad. That is where it hurts American products made by high-priced labor.

Cartel success is determined by certain well settled rules.

1. There must be uniformity of products sold by the cartel; dyes, nitrates, pulp, potash, all have been basic commodities successfully cartelized. Special papers and glazed bricks, on the other hand, have proved to be too specialized for successful handling.

2. A certain general equality in cost price and conditions of manufacture are necessary between the cartel components. Competition must be pretty even to prevent breaking over the contract because of excess profits by one unit.

3. There should be no commodity which can be easily substituted for the cartel lines. A cartel economically depends for its very life upon monopoly in order to force a good price from the trade. Obviously, you cannot sell natural indigo against the synthetic.

THE Franco-German potash agreement was for many years an important cartel. It was revived by an agreement between the two countries in 1924, by which the German monopoly is substantially restored in the form of a Franco-German alliance. The structure and the functions of the cartel are specifically prescribed by the potash law. All producers are obligated to turn over their output to the syndicate for sale. If new units are created by subdividing larger organizations belonging to the cartel, the granting of a quota is contingent upon the possession of deposits capable of producing an annual yield of 5,000 metric tons of pure potash for a period of 50 years and sufficient technical equipment to assure the production of raw salts corresponding to the quota. These quotas are revised every five years.

An interesting development was the provision by law that superfluous mines would be closed down and still maintain their quota until 1953. This resulted in the transfer of their quotas to more productive units at higher prices, thus facilitating concentration of the industry into the hands of stronger organizations.

When the Franco-German Agreement was put into effect the American market was taken as the basis for the potash agreement. The two countries regarded the American market as their particular property. France secured 31.2 per cent of the deliveries to the American markets. If one of the partners to the agreement could not supply its share, the orders were to be filled by the other partner upon the payment of 15 per cent commission. By 1925 a world agreement had been reached between France and Germany by which the former took 30 per cent and the latter 70 per cent of the world market. You can draw your own conclusions as to the effects and success of such efforts on an American organization trying to compete.

The international rayon agreement is an exceptionally interesting international chemical cartel. Apparently there is no specific understanding regarding the limitations of production, but a definite agreement on prices. The principal object of the cartel is to eliminate harmful competition through an agreement on prices and a certain specialization in marketing, but without a definite territorial division. The cross-licensing of the plants through the interchange of patents, technical improvements, and processes is for the purpose of improving the product.

Its most significant feature is the close financial inter-relationship between the members, extending in some

cases to the joint ownership of plants and in others to practical control. It is also significant that the most important members of the combination, Courtaulds and the Vereinigte-Glanzstoff, have branch plants or affiliates in the important consuming markets of the world.

Probably the international character of the rayon cartel was not only due to the patent factor but because the manufacturers of rayon required large amounts of capital, not only for production but for experimental work as well. It is an industry of many strategies in raw material, plant distribution, capacity of markets, tariff policy, and labor questions.

The three largest producers—Courtaulds, of Great Britain; the Vereinigte-Glanzstoff, of Germany; and Snia Viscosa, of Italy—entered an agreement in 1927, continuing one from 1925 of lesser scope which included the Dutch producer Enka. This international working agreement controls between 80 and 90 per cent of the world's rayon production, but the most important producers of acetate rayon, like the British Celanese, are not members of the combination, although the Vereinigte Glanzstoff is interested in the production of acetate rayon in combination with the I. G. Farbenindustrie A. G. through the joint ownership of the Aceta plant. It is understood that there is a partial adherence to this cartel between the Belgian Tubize interests on the one hand and the Vereinigte-Glanzstoff and I. G. Farbenindustrie on the other.

The United States consumes more rayon than any other country in the world. It produces more of the product than any other country in the world, but this prominent staple industry is directly or indirectly controlled by its affiliations with foreign interests through the combination of the international agreement. The German group of the Vereinigte-Glanzstoff is interested in plants in the United States, Japan, Austria, Czechoslovakia and the Netherlands. The British group is responsible for 55 per cent of this country's total produc-

What will be the effect on the commerce of the United States of this more aggressive competition? Analysis of these various factors will probably give an accurate answer:

1. *Who controls the raw materials used by the cartels?*

2. *What control of sales outlets is secured by the cartels?*

3. *What proportion of your industry's output is cartelized?*

4. *What government protection, patronage, and subsidy is accorded cartels?*

5. *What patent monopoly and international cross-licenses do cartels control?*

6. *What banking support do the cartels control?*

How can a domestic industry protect itself against the cartel? These steps will be helpful:

1. *Examine your banking support in forming new sales territories.*

2. *Take steps to prevent foreign interests dumping in the United States; that is a vital point to cartel supremacy.*

3. *Examine your patent situation in foreign countries. Can you freely export there? Can you use your United States Patents for cross licensing and sales agreements?*

4. *Are your raw material sources secure or are they foreign controlled?*

5. *What sales difficulties can you avoid by the proper forming of sales subsidiaries in foreign lands?*

tion and is an important producer in Canada, India, Spain, Norway, Germany, France and Czechoslovakia.

Post-war international banking is the foundation for the super-international cartel—the “entente.” National banking was the early basis of cartel success.

Germany first made cartels what they are because she was the first country to link manufacturing and banking with interlocking directorships as the basis for industrial expansion. Three hundred and eighty-five domestic cartels existed in Germany by 1895; in 1911 there were six hundred.

In Germany banking and manufacturing are partners. In other countries, until recently they have been potential enemies suspicious of one another, but not co-operators. Now comes the Bank of International Settlements to give further banking support to European prosperity which is based upon the cartel system.

Look back and see how Germany made herself industrially by this banking support of her manufacturers. The first stage of development took the form of banking cartels and combinations. Banks specialized in particular industries. Boards of those special industries and the banks interlocked.

At the beginning of this article, I stated there were two cartel weapons. The second was cross-licenses. Not only U. S. patents but foreign patents are handy weapons of trade for bartering for cross-licenses.

It is reported that a working agreement exists between I. G. Farbenindustrie of Germany, Imperial Chemical Industries, the Royal Dutch Oil Group, and the Standard Oil Company of New Jersey. A recent announcement has been made of a general offer of licenses to other American units for the use of certain hydrogenation processes. I. G. Farbenindustrie manufactures dyes, drugs, rayon, fertilizers, explosives, paints, lacquers, solvents, heavy chemicals, alloys, perfumes, raw films, photographic chemicals, paper-making chemicals, synthetic rubber, celluloid, and synthetic precious stones. With an employment of approximately 140,000 persons and as-

sets of approximately \$500,000,000, it is no mean factor in the cross-licensing field of international character in the chemical industry.

The patent license weapon is the backbone of the rayon cartel; finance is the next best weapon. Thus, while the United States is the largest producer of rayon in the world, the English-owned company controls half our output.

Meeting competition by cross-license first necessitates a patent foundation owned by the companies who are going to cross-license with patents existing in the respective countries. In some cases, it is better to take out the patents in countries where the goods are being sold and not manufactured if the patent expenses and taxes are low in those countries rather than take out the patents where the goods are being manufactured but where the patent expenses, taxes, and working charges are high.

MOST European countries require not only an annual tax but a working or manufacture or offers to manufacture, which are often expensive. Where a product is manufactured in one country only but sold in a number of other countries, obviously it is cheaper to stop the infringement at its source by taking out a patent in the country of its manufacture.

That is one way of overcoming the dumping evil, which is one of the weapons of meeting competition employed by the cartels. A cross-license accompanied by a price control of the patented product so licensed under certain conditions will be legal in the United States, and, of course, legal in foreign countries. Thus, the cross-license can be linked with the maintenance of the price structure. Again, the cross-license permits the joint employment of the efforts in the laboratories of different types of minds in different countries. In many cases, theoretical work of a foreign laboratory has found its first practical expression in the United States as a manufacturing proposition. Cross-licensing permits of just this result.

The Department of Commerce last November issued this warning on the international cartel menace:

Determined efforts on the part of foreign cartels, as well as individual manufacturers, to increase their sales quotas in competitive markets at the expense of our exporters make it imperative that American firms look to their laurels. The tendency of some exporters has been to rely on only a few foreign markets, some of which are becoming increasingly difficult. Many have lost sight of the fact that there are numerous regions of the world which have made amazing advancement in recent years, and that the economic life of many countries has been revolutionized—utterly transformed. There are constantly growing commercial opportunities which do not in the least involve poaching upon or raiding the old trade precincts.

One of the ways of combating this situation is through the Webb-Pomerene law that permits of the combination of exports which are prohibited by our anti-trust law for domestic purposes. It is significant that such foreign associations under the Webb-Pomerene law increased their foreign business from \$150,000,000 to about \$600,000,000 in about six years. The average increase in all American exports is about 8 per cent a year, but the increase in the existing export associations of their exports has been yearly running about 25 per cent a year. The necessity for this kind of co-operation against international cartels, if American industry is to sell abroad in large quantities, is obvious.

Europe Turns to American Processes for Motor Fuels

By GUSTAV EGLOFF

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DURING a recent trip to Europe it was convincingly brought home to me that in petroleum technology, world leadership is with the United States. In both petroleum production and refining, American methods and American experts are being employed to an increasing extent in every European country having an oil industry or seeking to establish one.

Our position of leadership is largely due to the fact that we were obliged earlier to solve the problems in fuel technology which Europe now faces. The use of the automobile developed in this country at a rate far outstripping Europe. We have at present one motor vehicle in service for every 4.6 persons. In the world, as a whole, the ratio is one car to 54.6 persons. Even in advanced European countries far fewer automobiles are in use than here. England has but 1 car to 30 individuals; France, 1 to 33; and Germany, 1 to 102. Russia has but 1 car to 6,000 population. In recent years, however, the automobile has gained rapidly in popularity also in European countries. At the present time the use of the automobile is increasing at a much faster rate abroad than in this country. In 1929, while the increase in automobiles in the United States was 8 per cent, the number of motor vehicles used in England, France, and Germany increased 12 per cent. In the last four years, the increase in the United States has been 32 per cent; in the rest of the world, 41 per cent.

The growing use of the automobile abroad has had a profound effect on the oil industry in foreign countries, not only in relation to supplies of gasoline but as to its quality as well. This foreign need for more efficient gasoline production is being met by introduction of American refinery methods. Modern pipe stills, modern fractionating columns, modern treatment of distillates by chemicals and adsorptive agents, and equipment of the modern American cracking process are being extensively installed abroad.

CRACKING is proving a particularly useful aid to Europe. The increased demand for gasoline has stimulated its production, but has furnished no market for fuel oil, which by the older refining processes is produced along with motor fuel. As a result, gasoline prices are high and the markets are glutted with heavy oils.

The situation in Roumania is of particular interest. In that country the use of the cracking process is of

recent origin, but is rapidly expanding. Although the first cracking units were installed but three years ago, cracking gasoline now makes up 18 per cent of the country's gasoline production. But more units are urgently needed. To satisfy the present gasoline demand the refineries without the cracking process are producing, besides the motor fuel, so much fuel oil that the market is flooded. Large quantities of heavy crudes are produced in some fields which yield little or no gasoline by ordinary distillation processes. Oil producers and refiners are even paying to have these now worthless byproducts carted away. One refiner using the cracking process was compensated at the rate of 50 cents per ton to take these heavy oils, which are excellent cracking stocks. The opportunity for cracking, with gasoline quoted at over 30 cents a gallon retail, is large. A foreign journal

recently stated that Roumania must crack 15,000,000 bbl. of fuel oil per year to produce a satisfactory balance among refinery products.

Poland is faced by a crude oil supply inadequate to furnish sufficient gasoline to meet the demand by simple distillation. The cracking process undoubtedly will achieve an important place in Poland's oil industry. Polish interests are alert to the need of installing cracking units to convert their oils into motor fuel, instead of fuel oil.

For many years, benzol has furnished a very important part of the motor fuel used in Europe. While the number of cars was small, the benzol output was sufficient to give European motorists all they needed from an anti-knock standpoint. With motor cars increasing in number, and benzol production approximately standing still, it appears that benzol can less and less meet European needs for anti-knock motor fuel. Therefore cracked gasoline is in demand, as its anti-knock characteristics make it a premium fuel. In countries having no crude oil re-

sources it is more economical to import fuel oil and crack it than to import the more volatile gasoline. Italy is now installing great reservoirs for petroleum and providing cracking units to guarantee her gasoline supply. England has cracking installations for utilization of imported fuel oil as a source of gasoline. France is building refineries, and planning the installation of cracking equipment. Other European countries which are now using American cracking equipment or have contracted for it are Belgium and Sweden.

The cracking units abroad are fabricated in the United States. All the resources of chemical and metallurgical engineering have been used in their manufacture. The superiority of the large reaction chambers made in this country is particularly notable. In their production, welding processes are used not rivalled elsewhere. Tubes and other portions exposed to corrosion are constructed of new resistant alloys. Some of these alloys are of European invention, but they are manufactured in American steel mills. That Europe thus relies on us for oil-refining processes and equipment is a high tribute to our men of science and technology.



DR. EGLOFF for many years has devoted his attention to the technology of oil cracking. The facts and impressions set forth in this article were gathered during a three months' stay in Europe. He went abroad primarily to read a paper on "Hydrocarbon Gases as a Source of Power in the United States" at the World Power Conference held in Berlin in June, but also visited other countries and conferred with many leaders in the chemical and petroleum industries

An Analysis of Mechanical Methods of DUST COLLECTION

By MARCEL A. LISSMAN

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SOLIDS carried in suspension by industrial gases may be separated from the gas in various ways. The methods employed fall broadly into two classes: (1) The solids are carried across the gas stream by gravity, radial acceleration, or an electric field acting on charged particles (settling chambers, cyclones, and electric precipitators); or (2) the solids adhere to surfaces located in the gas stream as in baffled settling chambers and filters.

When the dust adheres to surfaces, as in the second case, it is really because, due to radial acceleration, gravity, or electric charges, it has been forced to penetrate the quiescent gas film covering these surfaces. Hence, to obtain a high recovery the gas velocities must be low, so that eddies and turbulence do not disturb the quiescent gas film on the surfaces and disturb the accumulated dust. Besides, the total exposed surface must be large and the cross-section of the air streams between these surfaces must be small to obtain a high recovery. This is the case in filters.

IN ELECTRICAL precipitation, as used in the Cottrell process, the relations between the electric field and the electric charge accumulated on the particles is such that the separation of suspended particles from the gas stream is not affected by the size of the particles.

When gravity or radial acceleration are used to effect separation, then the ratio of mass to surface of the particles plays a very important part. For the conditions considered here it can be assumed without appreciable error that dust particles move at constant velocities. This means that the forces acting on the particles are in equilibrium. Gravity and radial acceleration are therefore neutralized at all times by the viscous friction of the gaseous medium, which for the sizes of particles here contemplated varies according to Stokes' Law. Of course, under changing conditions a new equilibrium must be reached, but the inertia of the particles is so small compared to the magnitude of the frictional forces that the momentum of the particles can be disregarded. This is equivalent to saying that "the suspended particles have no memory of the past nor knowledge of the future."

The range of size of suspended particles encountered

in industry is quite large. Assuming spherical shape, the rate of settling of particles of various sizes under gravity can be determined from Stokes' Law. In doing this we may consider that particles of which the shape varies widely from the spherical are replaced by spherical particles of such size that they fall at the same rate and, if necessary, the factor to be applied may be determined by experiment.

Settling Chambers—In settling chambers the suspended particles are removed from the gas stream by gravity. The frictional resistance encountered by a particle^{1,2} as given by Stokes' Law is

$$F = 6\pi nrv \quad (1)$$

where F = frictional resistance in dynes; v = velocity of particles in centimeters per second; n = viscosity of gas in c.g.s. units; and r = radius of particle in centimeters. The mass of a spherical particle is given by

$$m = \frac{4}{3}\pi r^3 W,$$

where m = mass of the particle in grams and W = density of particle in grams per cu.cm. And since the particle experiences a buoyancy equal to the weight of displaced gas, its effective weight is

$$w = \frac{4}{3}\pi r^3 (W - W')g \quad (2)$$

where w = effective weight in dynes; W' = density of gas in grams per cu.cm., and g = acceleration of gravity = 981 cm. per (sec.)².

A PARTICLE falls at such a velocity through the gas that the frictional resistance it experiences neutralizes its effective weight. The final velocity can be obtained from equations 1 and 2 and is found to be

$$v = \frac{2r^2}{9} \left(\frac{W - W'}{n} \right) g \quad (3)$$

Equation 3 then shows that the uniform velocity at which small particles fall in a settling chamber varies directly as the square of the radius and the density of the particle, and inversely as the viscosity of the gas. Table I gives the rate of fall of spherical particles of unit density through air at 212 deg. F. Particles of greater density would fall proportionately faster, while for higher temperatures the viscosity of the gas would be greater and the rate of fall would decrease in proportion.

¹ Gibbs, "Clouds and Smokes," 1924, p. 41.

² M. Seillan, "Note Sur les Depoussiéreurs Centrifuges," *Chaleur & Industrie*, Paris, 10: May, June, 1929; pp. 233-38, 289-93.

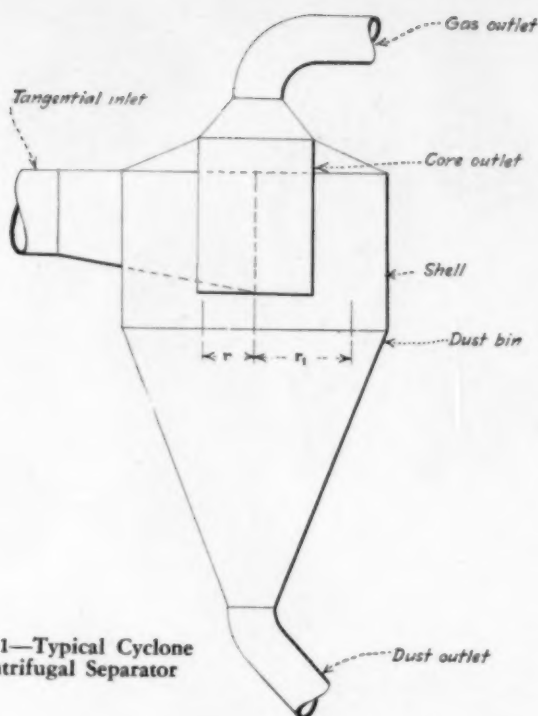


Fig. 1—Typical Cyclone Centrifugal Separator

Inspection of Table I would seem to indicate that it might be economically feasible to withdraw from industrial gases all particles larger than 44 microns, or 325 mesh, and perhaps down to 10 microns. However, a number of factors, which cannot readily be included in a simple mathematical analysis, account for the poor results actually achieved in large settling flues as compared to the results anticipated from an application of the simplified theory. As such a discrepancy also creeps in when large centrifugal separators are contemplated, it is desirable to give a qualitative discussion at this point.

From Table I it is seen that particles having a diameter of 10 microns fall at the rate of 5.73 in. per minute.

Table I—Rate of Fall of Spherical Particles of Unit Density Through Air at 212 Deg. F.

Microns	Diameter of Particles Inches	Mesh	Rate of Fall	
			In. per Min.	Ft. per Min.
104	0.0041	140	620	51.7
100	0.0039	...	573	47.8
74	0.0029	200	313	26.1
44	0.0017	325	111	9.25
10	0.0004	...	5.73	...
1	0.00004	...	0.0573	...
0.1	0.000004	...	0.000573	...

Hence, if it is planned to settle all such particles from a gas stream moving uniformly at say 60 ft. per minute, a flue 6 in. high and a little over 60 ft. long should be sufficient. However, for large gas volumes it is inconvenient to use a flue only 6 in. high. Therefore, a flue, say 10 ft. high, may be proposed, and in order to settle out all particles above 10 microns the length of the flue is increased to 1,200 ft.

An application of the simple theory (Stokes' Law) does not indicate the necessity of applying a scale factor to such a change, and when large settling flues are constructed, their operation is often found to be very inefficient.

Failure of the large settling flue can be ascribed to a "major turbulence factor." With large bodies of gases it is practically impossible to obtain absolute rectilinear stream-line flow. This is especially the case when the gases are hot, as temperature differences will cause con-

vection currents. These currents and those due to non-uniform pressure and velocity distribution throughout the cross-section of the gas stream, produce a turbulent condition which prevents the small dust particles from settling out of the gas stream, just as much finer suspended particles are prevented from settling out of quiet air by Brownian movements. This turbulence factor is a complex function of the temperature differences in the gas stream and of poor velocity and pressure distribution due to numerous causes.

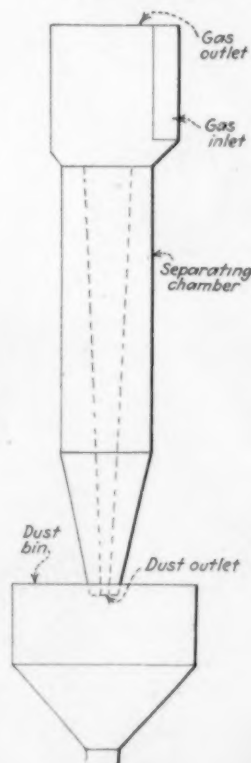
Centrifugal Separators (Cyclones, Multiclones)—It is convenient to measure the active force which causes suspended particles to move across the stream lines of the gas flow in terms of g , the acceleration of gravity, and to call the resulting numerical ratio the separation factor of the device in question. For instance, if a certain cyclone has a separation factor of 50, this means that the radial acceleration acting on suspended particles within the cyclone is 50 times the acceleration of gravity. A settling flue, therefore, has a separation factor of unity.

A CENTRIFUGAL separator, or a cyclone, so-called, utilizes radial acceleration to effect separation of particles suspended in gas streams. Fig. 1 shows an ordinary cyclone. It is composed of an outer cylindrical shell having a tangential or involute inlet, and terminating in a cone or dust bin which has a dust outlet connection at the bottom. A concentric core outlet, open at the lower end, connects to a gas outlet at the top. Entering, the gas stream is forced to spiral downward in a helical path forming an outer vortex, after which it returns, spiraling upward towards the outlet core, and forming an inner vortex. Only a small part of the outlet cross-section is utilized by the whirling gas of the inner vortex: namely, a ring of small radial depth just inside the central core walls, due to the high rotational energy of the inner vortex.

As a rule, the radius of the inner vortex is about one-half the radius of the outer vortex, and such a relation will be assumed here as it leads to simple mathematical expressions. While the gases pass through the apparatus, heavy suspended particles are thrown against the outer walls of the cyclone, out of the main gas stream, and then fall toward the dust outlet.

A centrifugal dust collector such as described above is virtually a fan with reversed gas flow. One distinction is that, in a fan, the angular velocity of the gas is constant while passing through the impeller wheel, due to the constraint of the vanes; while in a cyclone, disregarding frictional resistance, the angular momentum remains constant during the passage of the gas through the apparatus. Frictional resistance encountered in a cyclone is generally small compared to the total energy in the gas stream, and under these conditions the above simplifying assumption is justified. Therefore, in a cyclone with radius

Fig. 2—Typical Single Multiclone Tube



of the inner vortex one-half that of the outer vortex. the tangential velocity in the inner vortex is twice that in the outer vortex. This has been repeatedly checked by actual tests. Consequently, if H_1 is the velocity head due to a tangential velocity V_1 in the outer vortex, then the velocity head in the inner vortex must be $4H_1$.

Hence, to force the gas through the apparatus it is necessary, besides the initial velocity head H_1 , to expend a pressure equal to $3H_1$. The energy expended upon the gas, except for a small fraction used up in frictional resistance within the apparatus, is present in the form of kinetic energy of the gas stream in the outlet core. However, as this kinetic energy is present in the form of a rapidly whirling, shallow film of gas within the outlet core, it is not easily recoverable in practice. Attempts to do so invariably result in disturbances and eddies which affect adversely the operation of the apparatus.

IT MUST be noted that the velocity V_1 referred to above is that present in the outer vortex of the cyclone and it is generally larger than the velocity in the inlet pipe due to the nozzling of the inlet stream caused by the whirling gas within the cyclone. A mathematical derivation of the draft loss in a cyclone follows:

Derivation of Draft Loss Formula—Let V_1 be the tangential velocity of the gas in the outer vortex at a radial distance r_1 (see Fig. 1), where the pressure is p_1 and the density of the gas, W_1 . Due to the conservation of angular momentum, at any radial distance r , the velocity of the gas is such that $V_1 r_1 = V r$, and therefore

$$V = \frac{V_1 r_1}{r}$$

If the pressure at r is p , then the density will be

$$W = \frac{W_1 p}{p_1}$$

The rate of change of pressure due to unit volume of gas at a radial distance r is given by the differential equation

$$\frac{dp}{dr} = \left(\frac{W_1}{p_1 g} \right) \frac{p V^2}{r}, \text{ and as } V = \frac{V_1 r_1}{r} \text{ this gives}$$

$$\frac{dp}{dr} = \left(\frac{W_1}{p_1 g} \right) p \frac{V_1^2 r_1^2}{r^3} \text{ or } \frac{dp}{p} = \left(\frac{W_1 V_1^2 r_1^2}{p_1 g} \right) \frac{dr}{r^3}$$

$$\text{which integrates into } \log cp = -\frac{1}{2} \left(\frac{W_1 V_1^2 r_1^2}{p_1 g} \right) \frac{1}{r^2}$$

Therefore, the ratio of the pressures at two points r and r_1 is

$$\log \frac{p}{p_1} = -\frac{1}{2} \left(\frac{W_1 V_1^2 r_1^2}{p_1 g} \right) \left(\frac{1}{r^2} - \frac{1}{r_1^2} \right)$$

For cases where $r = \frac{1}{2} r_1$, the factor $\left(\frac{1}{r^2} - \frac{1}{r_1^2} \right)$ becomes

$\frac{3}{r_1^2}$, and the above equation reduces to

$$\log \frac{p}{p_1} = -\frac{3}{2} \left(\frac{W_1 V_1^2}{p_1 g} \right) \quad (4)$$

showing that for similar cyclones the draft loss is independent of the dimensions of the cyclones, but is a func-

tion of the tangential velocity in the outer vortex, V_1 , and the density of the gas.

The units in Equation 4 can be checked by noting that the right-hand member must be non-dimensional as it can be written as an exponent. If $W = \text{lb. per cu.ft.}$, $V = \text{ft. per sec.}$, $p = \text{lb. per sq.ft.}$, and $g = \text{ft. per}$

$(\text{sec.})^2$, we have $\frac{\text{lb./ft.}^3 \times \text{ft.}^2/\text{sec.}^2}{\text{lb./ft.}^2 \times \text{ft./sec.}^2}$, which is non-dimensional as required. Therefore, equation 4 can be written

$$\frac{p}{p_1} = e^{-\frac{3}{2} \left(\frac{W V_1^2}{p_1 g} \right)} \quad (5)$$

In any commercial cyclone, the ratio $\frac{p}{p_1}$ is very close to unity, and this means that the exponent on the right-

hand side is sensibly zero. Under such conditions it is sufficiently accurate for purposes of computation to write

$$e^{-x} = 1 - x$$

Hence Equation 5 becomes

$$\frac{p}{p_1} = 1 - \frac{3}{2} \left(\frac{W_1 V_1^2}{p_1 g} \right) \text{ or}$$

$$p_1 - p = \text{draft loss}$$

$$= \frac{3}{2} \frac{W_1 V_1^2}{g} \quad (6)$$

This draft loss is in lb. per sq.ft., and changing to inches of water gives draft loss

$$= 0.288 \frac{W_1}{g} V_1^2 \text{ in. water} \quad (7)$$

Assuming $V_1 = 60$ ft. per second and a temperature of 100 deg. C., giving $W_1 = 0.0592$ lb. per cu.ft., we have

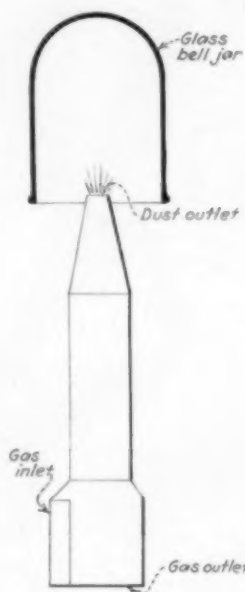


Fig. 3 — Multiclone Tube Inverted to Study Dust Discharge

$$\text{Draft loss} = \frac{0.288 \times 0.0592}{32.2} \times (60)^2 = 1.9 \text{ in. water.}$$

This does not include the tangential velocity head in the outer vortex, which also has to be supplied, and which is

$$H_1 = \frac{60^2}{3.9^2 \times 373} = 0.633 \text{ in. water.}$$

The total pressure drop necessary to force the gas through a cyclone of these proportions is 2.53 in. of water, corresponding to four tangential velocity heads.

The chief advantage of the mathematical derivation is that it shows the effect of the several variables upon the draft loss, as for instance, varying the proportions of the cyclone. However, if the volume of gas passing through the cyclone is very small compared to its dimensions, then frictional losses can no longer be disregarded and the effect of these losses must be determined by experiment. This holds also for any cyclone containing baffles of various kinds introduced for the purpose of destroying the inner vortex, which disturbs the normal operation of the cyclone, creating eddies, so that the law of conservation of angular momentum can no longer be applied.

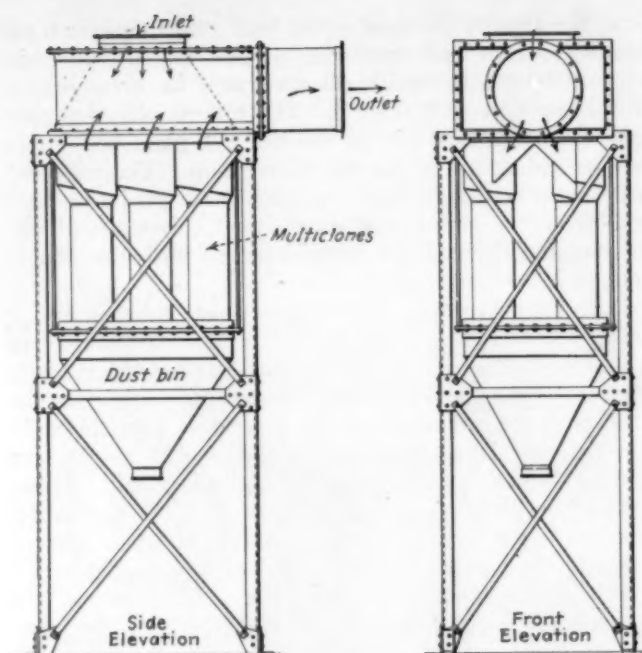


Fig. 4—Side and Front Elevations of Commercial Six-Tube Multiclone Separator With 9-In. Tubes

Separation Factor in a Cyclone—If V_1 is the velocity in the outer vortex of a cyclone in ft. per sec. and r_1 the radius of the outer vortex in feet, then the radial acceleration in the outer vortex is $\frac{V_1^2}{r_1}$ which gives a separation factor of $\frac{V_1^2}{r_1 g}$, where g is the acceleration of gravity. But in the inner vortex, $V = 2V_1$, while $r = \frac{r_1}{2}$. This gives a separation factor of $\frac{8V_1^2}{r_1 g}$, showing that the separation factor in the inner vortex is eight times that in the outer vortex.

In practice, the initial velocity V_1 in the outer vortex is limited by the draft loss which can economically be expended upon the cyclone. The derivation of the draft loss formula of a cyclone shows that for the same entering velocity in similar apparatus, the draft loss is independent of the size of the apparatus as it is seen to depend solely upon the ratio of the radii of the inner and outer vortices. Consequently, if the same draft is expended upon similar cyclones, the separation factors obtained vary inversely as the diameters of the cyclones. A velocity of 60 ft. per second in the outer vortex can be readily obtained commercially. Table II shows the variation of the separation factors with such an initial velocity.

Table II—Separation Factors for Cyclones
(Outer vortex velocity, 60 ft. per second)

Diameter of Cyclone	Separation Factor (Times Gravity)	
	Outer Vortex	Inner Vortex
20 ft.	11.3	90
10 ft.	22.4	179
5 ft.	45	358
2 ft.	112	896
1 ft.	224	1,790
8 in.	336	2,690
5 in.	538	4,300
4 in.	672	5,380
3 in.	896	7,170

Table II shows that for very large cyclones, the separation factor obtained is of the same order of magnitude as that of settling chambers. Just as in the case of settling chambers, there are several factors which affect

the operation of large cyclones adversely, but which cannot readily be included in a mathematical analysis. The effect of some of these factors upon the results obtained is in some cases even greater than the effect due to a reduction of the separation factor with increasing diameter. Some of these factors will be qualitatively discussed below.

Travel of Particles—For similar cyclones, both the maximum and average travel of suspended particles necessary for separation varies directly as the diameter, while the separation factor varies inversely as the diameter. Thus, as the separation factor decreases, the distance required for separation increases. This results in a greater inability of large cyclones to handle very fine suspended material than would appear from an inspection of Table II.

Major Turbulence Factor—In large cyclones the major turbulences and eddies are sufficiently pronounced to prevent fine particles from being separated from the gas stream, although according to Table II, the size of such particles seems to be well within the range that can be handled with the separation factor obtained.

Rotational Stiffness—In very small cyclones, the rotational energy of the gas stream is so high, and the increase in kinetic energy of the gas stream even for a small radial displacement toward the axis of rotation is so great, that considerable rotational stiffness is imparted to the gas stream. Under these conditions the stream lines are very smooth and free from local eddies, resulting in conditions very favorable to the successful separation of very fine suspended particles. Such small cyclones sometimes show recoveries of fines that could not have been anticipated from observation of larger cyclones on the same material.

The Multiclone—In industrial operations the volume of gas to be treated is generally quite large. In order to reap the advantages inherent in the use of small cyclones, and yet handle large gas volumes, it is necessary to operate a large number of these in parallel. When this is attempted a number of problems are encountered, some of a theoretical, others of a practical nature.

After an extended investigation in which thousands of set-ups were tried under controlled conditions a solution to these various problems, which up to this time had made parallel operation of small units impractical, was obtained. This practical solution is embodied in the "Multiclone," or multiple cyclones system.

In Fig. 2 there is shown a typical single Multiclone tube. It is seen that the cylindrical shell extends considerably below the outlet. Due

Fig. 5 — Commercial 12-Tube Multiclone Separator With 4-In. Tubes



to the high rotational stiffness prevailing in a small unit, the outer vortex containing the suspended particles is kept separate from the inner vortex traveling toward the gas outlet. The outer vortex reaches to the dust outlet. Pressure expended upon the unit causes the gas in the outer vortex to be forced radially inward, while the dust particles are forced outward by radial acceleration. On account of the extent of the separating chamber below the outlet core, the inward component of motion of the gas passing through the tube is only 1/30th to 1/50th of the entering velocity. Thus the component of motion which would entrap the suspended particles is kept as low as possible, while the radial acceleration of the particles causing them to travel in the opposite direction is made very large, several hundred times the acceleration of gravity.

IN A UNIT, such as Fig. 2, it is sufficient for a particle to travel only a short distance to become separated from the gas stream, and to reach the walls of the separating chamber. Gravity is only a minor factor in conveying the separated particles into the dust bin. Instead, the particle penetrates the gas film immediately adjacent to the walls of the separating chamber. Due to the wall friction the whirling of this gas film is very sluggish compared to the whirling in the outer vortex. However, the residual whirling is kept sufficiently active to prevent dust particles from settling out of the gas film and adhering to the walls of the separating chamber. Due to the frictional resistance of the walls of the separating chamber, the gas whirls at lower velocities at the bottom of the chamber. The axis of the vortices is a constant pressure region. Consequently, the pressure due to the whirling gas acting on the gas film next to the walls is lower at the bottom than at the top. The resulting pressure difference causes an active circulation of the gas film next to the walls toward the dust outlet and into the dust bin. This circulation is sufficiently active to keep the walls of the separating chamber clean and free from adhering dust.

After reaching the dust bin, the particles are allowed to settle out while the gas that acted as carrier returns

along the axis of the dust outlet back into the separating chamber. That such conveying of dust into the dust bin is positive can be easily demonstrated by arranging a Multiclone unit as in Fig. 3. The tube is placed upside down with the dust bin at the top. A glass bell jar is used as a dust bin to permit observation. The collected dust suspended in its carrying gas film is projected in a cone from the rim of the dust outlet. In tests, no reduction in efficiency has been observed with the Multiclone unit operated upside down.

Dust Trap Features—The proportions shown in Fig. 2 cause a Multiclone unit to perform as a very efficient dust trap. There is a very decided suction present along the axis of a separating unit from the dust outlet at the bottom, to the gas outlet at the top. If a particle could travel along the axis from the dust outlet to the gas outlet it would be lost from the collecting unit. However, an inspection of Fig. 2 shows that the gas outlet subtends only a very small solid angle when viewed from the dust outlet. Due to the active whirling in the separating chamber, the path of a particle along the axis is essentially unstable and it is thrown into the inner vortex. Table II shows that in the inner vortex the separating factor is very large, up to several thousand times gravity.

A SMALL radial displacement due to the influence of this large force is sufficient to cause the particle to penetrate the outer vortex and to be conveyed to the dust outlet. Tests have shown that particles larger than 3 to 5 microns do not remain in the inner vortex for a sufficient length of time to become lost with the outlet gases.

Commercial Multiclone Units—Two views of a commercial 6-tube Multiclone unit with 9-in. tubes are shown in Fig. 4, while Fig. 5 shows a 12-tube assembly with 4-in. tubes. As shown in Table II, the separating factor in the outer vortex of a 4-in. tube is nearly 700 times gravity, so that a unit of this type should be effective on extremely small particles, and actual tests have shown a collection efficiency of over 99 per cent where the diameter of the average particle was about 5 microns.



Electrolytic Metal Cleaning Without Corrosion

ELECTROCHEMICAL CLEANING of metals has been practiced in the past, but it has been the misfortune of the process that it has tended to accelerate pitting, corrosion, and hydrogen embrittlement. A new and extremely simple electrochemical method which does away with these disadvantages has been developed by the Bullard company, of Bridgeport, Conn., and is embodied in the recently patented Bullard-Dunn process of metal cleaning.

In their fabrication, metal parts often become coated with oxide as a result of heating or corrosion. It is ordinarily necessary to remove the oxide very completely before subsequent operations such as machining, pressing, or plating can be carried out. Several methods are used, including sand-blasting, scratch-brushing and tumbling; and acid-pickling, either as such or under electrolytic conditions. The mechanical methods are slow

and frequently incomplete, while pickling, even with inhibitors, results in a small but often harmful amount of corrosion, pitting, and hydrogen embrittlement.

Corner in the Metal Cleaning Laboratory: Acid Bath at Left and Caustic Bath at Right

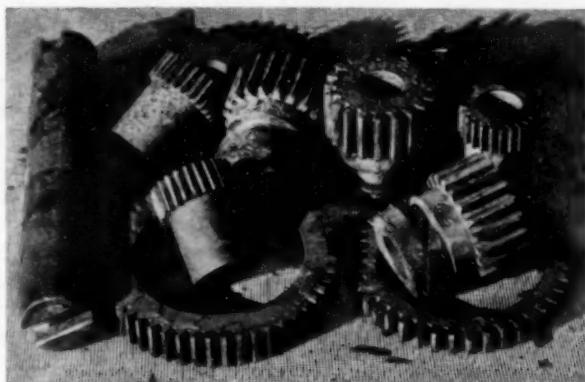


A special feature of the Bullard-Dunn process is the use of a metallic film which deposits on the metal to be cleaned the instant each particle of scale is removed. So that the metal may be completely protected from attack by the bath, the film is itself a metal, resistant to the bath, such as lead, tin, or zinc.

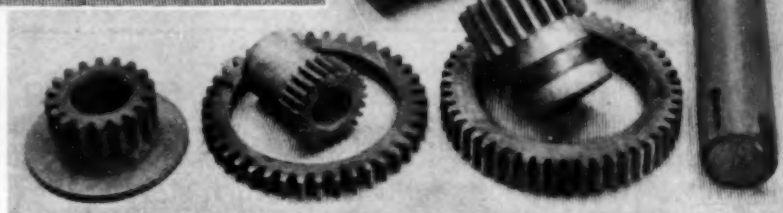
The process is extremely simple in operation. Equipment includes two steam-heated, ventilated tanks, and two wash tanks. The acid tank is lined with lead or

any bit of metal is exposed, lead-ion deposits on it as a thin, adherent, protective metal film.

This prying and coating action goes on continuously until all of the scale has been removed and all of the surface coated. As high current densities are used, this action is very rapid and takes ordinarily only a few minutes even for a large object. The time, of course, is increased if the scale is considerable in quantity, or if the metal is one having a high inherent corrosion resistance. Over-exposure to the acid bath results only in the development of a porous, spongy deposit over the adherent coating which is easily removed if necessary. In subsequent operations, such as machining and deep drawing, the film usually is left on, for it forms an excellent metallic lubricant. Or if the surface is to be electroplated, the plating may take place directly over the film,



Above: Before Cleaning —
Metal Parts Covered With
Dirt and Scale



Left: After
Cleaning — the
Same Parts Are
Bright and Clean
With Smooth,
Sharp Surfaces,
and Original
Tool Marks
Visible

rubber and the caustic tank is made of iron. Anodes are made of whatever metal—as for example lead—is to be used for the protective film; or if metal salts are to be added directly to the bath, the anodes are of carbon. The cathodes in any case are the objects to be cleaned. The current supply is 6 volts d.c.

Solution for an acid bath using lead anodes contains a few ounces each of sulphuric acid, hydrochloric acid, and common salt per gallon of water. This composition is not at all critical. Principally, it is necessary that the bath be acid, and for this purpose H_2SO_4 is excellent because of its cheapness. But there must be a certain quantity of lead-ion in solution, so HCl is added to produce the slightly soluble lead chloride. The caustic solution contains a small quantity of tri-sodium phosphate, soda ash, and caustic soda, and this also is not critical. The acid bath is operated at about 150 deg. and the caustic bath at about 200 deg. F., but neither of these temperatures requires careful control.

If the piece of metal to be cleaned is covered with dirt and grease, as well as scale, it is first suspended as the cathode in the caustic tank. Between the action of the solution and the electrolytically released hydrogen, which evolves on the metal surface, the dirt is very quickly removed. After a hot water wash, the piece is suspended as the cathode in the acid tank, where, assuming that the protecting film is to be lead, action is roughly as follows:

Ionic hydrogen, resulting principally from the dissociation of water, migrates to the cathode and, losing its charge in contact with the metal underneath the oxide scale, is evolved in minute bubbles of molecular hydrogen. The hydrogen in expanding pries off the scale, bit by bit, and bubbles to the surface. And as soon as

as the coating is very adherent; but if it should be objectionable, it can be removed in a minute or two by placing the object as the anode in the caustic bath. Caustic corrosion of ferrous metals is extremely slow, and even a considerable over-exposure will do no damage.

At a recent showing of the process, its harmless character and its lack of hydrogen embrittlement were convincingly demonstrated. A tiny hairspring for a watch was left in the bath for half an hour. By that time the lead coating was very spongy, but when it had been removed at the anode in the caustic bath, the writer examined the spring and found it to be as bright as ever, although lacking its blued oxide coating. It possessed apparently all its original elasticity.

As a result of the success of the process, which was developed primarily for use in its own shops, the Bullard company is now offering it under a licensing arrangement. Its several advantages, such as complete protection for the parts treated, excellent cleaning even in such hard-to-get-at places as the roots of threads, its low cost of operation, and its foolproof character, would seem to make it a most attractive possibility for many of the metal-working industries.



In a paper presented in September before the American Society of Mechanical Engineers, T. P. Thomas, of the Westinghouse company, described a method of salvaging worn iron parts by electrodeposition. He uses pure iron anodes in a bath of ferrous ammonium sulphate containing a little ferrous carbonate, freshly precipitated, and a little powdered charcoal. Deposits so produced are satisfactory for building up gages and shafts and for many other purposes.

Process Industries Need Workable Cost System

By L. C. PEABODY

Longview Fibre Company, Longview, Wash.

THAT day is about over in our industrial growth when the office, because of its constant demands for detailed plant records, was tolerated as an unavoidable misfortune. The office man, caught between his executive's demand for prompt and pertinent data and the operator's oft-expressed reluctance to assist, worked under the cloud of inefficient results due to inefficiently acquired data. And there was justice in the plant operator's attitude, for with the beginning of cost keeping came an irresistible tendency to encroach more and more on the superintendent's and foremen's time for tiresome and involved operating data.

Plant operators make unwilling and ineffective office clerks at best, and it has become increasingly obvious that cost accounting, to be valuable and significant, must combine two most desirable features: It must be simple, and it must be coordinated to the operation. This is peculiarly applicable in the process industries where bulk materials, skilled labor and supervision, and costly and intricate equipment are involved. Cost information cannot originate in the office; records must come from a variety of sources throughout the plant—apportionments of labor, usages from stores, estimates from the engineering department, reports of operations, and production figures from every department of the mill. Because of this, unless contact is close and friendly, unless only the definitely vital and requisite information is sought, and unless the routine of plant record keeping is organized so as to be easily maintained, results will scarcely be worth the effort. Superintendents, foremen and straw bosses are interested primarily in the quality and quantity of the material produced. They are not record keepers and willingly admit it. The cost accountant must plan accordingly or fail. In an admittedly disconnected way may I mention a half dozen features of a practicable and workable cost system for process industries.

There are two angles of approach in drawing up or revising a plant report. "What more can I include that might somehow be useful?" or "What more can I eliminate without sacrificing essential data?" The second approach will pay dividends not only in relieving operators of burdensome and irksome record keeping but in promoting accuracy of figures through simplification. How unscientifically forms are sometimes drawn up; and how reluctantly they are modified once they are inaugurated!

Where bulk materials are concerned, whether raw materials, materials in process, or finished goods, inventories should be taken when stocks are low, rather than at fixed periods. In such cases as where an engineer's estimate of the tons of material in a pile is involved, the percentage of error may be as high as 10 per cent.

Regardless of the percentage, the actual error reduces as the quantity involved reduces. The same applies in the various plant inventories. A complete physical inventory of a heavily stocked storeroom costs much in time and effort. Inventory the individual items when you reach your set minimum for that item and before the incoming supply arrives. This method, with properly kept book records will save time, insure greater accuracy, and satisfy the requirements of approved office procedure.

In close relationship to the above suggested method for physical inventories, must be built up a simple but accurate method of recording book inventories. So far as I know, there is no better method than the type of visible card-index record such as Kardex, Acme, and others that have been made available. A systematic posting of receipts and usages with a running total on each item, whether there be two items or two million, with established minimums and maximums, and with visible signals (usually celluloid tabs) to set off items needing particular attention—these insure accuracy, make information instantly available, and preclude the necessity of frequent physical inventories. And the use of such files is varied: store room, employment, raw stock, finished stock, purchasing records. Note that

such records help not only the cost clerk but the engineer, the operator, the straw boss.

Costs may have originally served the single purpose of fixing selling prices. They are now even more vital for cost reduction and careful analysis and comparison, not only by mill executives but by engineers, department heads, and foremen. Co-

operation of mill employees, co-ordination of cost keeping to operation—these can best be obtained through sharing the data obtained with all directly concerned. Under present competitive conditions no plant can afford to "fly blind" as to costs, and efficiency of operation will come only where cost statistics are presented to those in charge of operations. They must be well organized and simple, they must be promptly available, and they must be shared with all concerned.

Accounting based on a year of thirteen equal periods of four weeks each can greatly simplify cost routine and make quick and searching analysis possible to all. Using the calendar month with 24 working days in February and 27 in January or March; the proper distribution of fixed charges, monthly salaries, and overhead, to determine unit costs is difficult because complicated. A shift to the thirteen-period year can be made with little effort, with slight added cost, if any, and by any single organization so desiring.

Cost figures—the record of past performance—must point ahead to carry their full significance. Systematic recording is requisite, but the determination of future costs based on known facts of experience is even more essential. This must be a result of the establishment of standard costs for various operations, such standards to be rechecked and redetermined with reasonable frequency to fit changes in operating method. Though only touching on this point, it is that which designates a cost department as dynamic instead of static; it elevates it out of the realm of routine into a place of deserved significance.

The author gives a half dozen features of a practicable and workable cost system for process industries, which elevates the cost department out of the realm of routine into a place of deserved significance.

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion
of articles and editorials
or other topics of interest



Smoke Nuisance Control

To the Editor of *Chem. & Met.*:

Sir:—In the June, 1930, issue of *Chem. & Met.*, the writer drew attention to the lack of scientific legislation dealing with the subject of nuisance control in the United States and further cited the fundamental principle essential to nuisance control legislation.

Obviously, nuisance control legislation cannot validly embody scientific means that are not known to the technique of nuisance control. On the other hand, the scientific basis for such legislation is to adopt the best practicable means known. In other words, legislation must follow the advance made in nuisance control and not attempt to precede it.

Nuisance control legislation that disregards known scientific facts cannot have much practical value and as a consequence is futile. As an illustration of such futility, Information Circular 6262, March, 1930, of the Bureau of Mines, has come to the writer's attention. It is entitled "Proposed Standard Smoke Ordinance" and has been prepared by a joint committee made up of representatives of several civic and technical bodies.

The first question that may be asked regarding this so-called Proposed Standard Smoke Ordinance is, what is its purpose? Obviously, to conserve coal; and, such being the case, why not entitle the legislation accordingly? The *alleged* purpose is to abate atmospheric pollution. If the efficient burning of coal in reality meant the abatement of atmospheric pollution, there would be justification for the legislation, but such is not the case; hence this "Proposed Standard Smoke Ordinance" has no scientific or legal status.

The presumption is that, if black smoke of a certain intensity is slightly reduced, as a consequence atmospheric pollution is abated. On that ground the validity of the legislation rests. It is not apparent that there is any scientific reason for defining the term "smoke" as outlined in Section 3 of the "Proposed Standard Smoke Ordinance," which reads as follows:

The production or emission within the city of smoke, the density or shade of which is equal to or greater than No. 3 of the Ringlemann chart, from any stack, except that of a locomotive or steamboat, for a period or for periods aggregating two minutes or more in any period of fifteen minutes, and the emission of such smoke from any locomotive or steamboat for a period or for periods aggregating one minute or more in any period of eight minutes, is hereby prohibited.

Obviously, an aerosol, which may be designated as a smoke, is not dependent upon the color of its component particles, nor does nuisance really depend upon the color of smoke particles emitted from a chimney.

In the opinion of the writer, the "Proposed Standard Smoke Ordinance" as a nuisance abatement measure is invalid for the following reasons:

1. The definition of smoke is inadequate, as smoke from burning powdered coal causes more nuisance than by other burning methods, yet would not violate the proposed ordinance.

2. A permit granted to create a serious nuisance, in view of well-known means to abate it, is not a valid permit.

3. A nuisance is a question of fact; thus smoke from burning powdered coal cannot be legalized by police regulation.

4. There is insufficient data to prove that under any circumstances of coal burning, atmospheric pollution is abated by conformity to the stipulations as set forth in Section 3, cited above.

5. On the ground that the efficient burning of coal does not abate atmospheric pollution, a municipal corporation has no jurisdiction to compel the use of any particular device for coal burning or the burning of any particular kind of coal.

Atmospheric pollution due to the burning of bituminous coal can be abated only by the collection of smoke produced therefrom at the source of its origin. If smoke collection from central stations keeps pace with the distribution of electricity, steam, and hot water, then substantial progress in the prevention of atmospheric pollution due to this source will have been made.

Looking toward the accomplishment of abating atmospheric pollution, the first necessary step is to repeal all existing so-called smoke ordinances. No legislation at all is better than that which now obtains or that proposed, as neither is smoke abatement legislation.

Commissioner, Trade Waste,
City of Cleveland,
Cleveland, Ohio.

R. D. MACLAURIN.

Transportation Regulations

To the Editor of *Chem. & Met.*:

Sir:—I note on pages 583 and 584 of the September, 1930, issue of *Chem. & Met.* an article relating to the transportation of compressed gases, in which several mistakes have been made in interpreting the Interstate Commerce Commission Regulations.

The "Compressed Gas" placard shown is only authorized for application to tank cars containing non-inflammable compressed gases. Furthermore, the "Inflammable" placard, which is not shown in the cut or referred to in the note, is required on cars containing packages bearing the red inflammable compressed gas label and on tank cars containing inflammable compressed gases.

In the table at the top of page 584, it is indicated that items 14 and 15 may be shipped in I.C.C. 5F drums. No such provision is made in the new I.C.C. Regulations. Furthermore, only gases having a pressure not exceeding 75 pounds per square inch at 105 deg. F. can be shipped in I.C.C. 104A tanks. A note to this effect should be shown with the original table.

On page 584 the note "Permitted Filling Densities" shows the maximum total load in tanks on a single car as 600,000 pounds, whereas the limit is 60,000 pounds, as prescribed in paragraph 433 of the I.C.C. Regulations.

Chief Inspector,
Bureau of Explosives,
New York.

B. W. DUNN.

CHEMICAL ENGINEER'S BOOKSHELF



Analysis in a Steel Works

RAPID METHODS FOR THE CHEMICAL ANALYSIS OF SPECIAL STEELS, STEEL-MAKING ALLOYS, THEIR ORES, GRAPHITES AND BEARING METALS. By *Charles Morris Johnson*. Fourth Edition. John Wiley and Sons, Inc., New York, 1930. 729 pages. Price, \$7.50.

Reviewed by C. P. LARRABEE

THIS revised edition of the author's well-known book contains detailed directions for all the analyses that a steel works laboratory might be called upon to perform. The new material is in the form of 18 appendices to the third edition, consisting of 176 pages with 28 illustrations. Nearly all the procedures are those used in the author's laboratory, very few being taken from the literature. The appendices include the author's latest ideas on a carbon combustion train, evolution sulphur, volumetric phosphorous, silicon, nickel, chromium, vanadium, manganese, copper, molybdenum, and many other procedures for special alloys. Appendix XV, of 31 pages, is a brief presentation on the analysis of non-ferrous metals which is a much needed addition to a book of this character. Appendices XVI to XVIII inclusive, dealing with the metallography of steel, are largely taken from the literature without critical treatment and with some mistakes in references. Bringing chemistry and metallography together seems a step in the right direction.

It is a pity that no mention is made of the time-saving and accurate electrometric methods now in common use. All the appendices appear hastily written and proofread, as occasional misspelled words, ambiguous phrases and typographical errors indicate. The constant use of Bureau of Standards Standard Samples of Steel and Pure Chemicals, however, as a criterion of the accuracy of his determinations, can well be adopted by other laboratories.

Basic Unit Operations

BETRIEBSMITTELKUNDE FÜR CHEMIKER. By *M. Dolch*. Verlag, Otto Spamer, Leipzig, 1930. 336 pages. Price, 20 M.

Reviewed by W. T. READ

THIS TEXT is concerned primarily with a description of unit chemical engineering operations and the equipment with which these operations are carried out. The first part has to do with transfer of materials, and the second with conversions of materials. In the latter section the division is on the basis of whether or not a change of temperature is involved.

The illustrations are excellent, consisting entirely of line drawings, mainly rather simple and all quite clear, because of the heavy lines and adequate lettering. The

book would be much more valuable if there were less printed description and more drawings of the sort used. American readers will miss quite a number of well-known pieces of equipment. There is very little in this book of the fundamental principles of chemical engineering, and no formulas, curves, or data on which to base calculations. However, this is not the purpose of the book, its object being to describe and illustrate the use of the tools of the chemical engineer. There is a definite place for a text of this sort, and whether or not it should be used in courses in chemical engineering, or as outside reading and reference, is a matter of individual judgment. Teachers of chemical engineering will find the preface interesting.

Metal Scrap Recovery

METALLURGY OF WHITE METAL SCRAP AND RESIDUES. By *Edward Richard Thew*. D. Van Nostrand Company, Inc., New York. 1930. 399 pages. Price, \$5.50.

Reviewed by WILLIAM H. FINKELDEY

AS THE first truly comprehensive book on the recovery and refining of non-ferrous metal scrap and residues, its publication is most timely. The ever-growing use of secondary metals and alloys by our large non-ferrous metal-consuming industries has been paralleled by remarkable strides in improving the processes and methods for recovery.

The first chapter covers the smelting of tin and white-metal residues, with descriptions of reverberatory and blast furnaces and a comparison of the practice followed with each type of furnace, refining of tin, and the influence of the various common impurities on the properties of the finished metal.

The next seven chapters are devoted to a general description of white-metal alloys. The composition and properties of tin-base, lead-base, and zinc-base bearing metals are given with some information on the influence of casting temperature and the effect of impurities on the properties of the bearing metal alloys. In a similar manner the author discusses type-metal alloys, soft solders, (including tin, lead, cadmium, and aluminum solders), pewter, Britannia metal, fusible alloys, and lead shot.

In the chapter following, the melting and refining of white metal scrap is covered in detail, whereupon four chapters are devoted to the smelting and refining of lead base alloys. This is followed by an equally detailed description of the refining of secondary worklead and old scrap in melting pots and reverberatory furnaces.

A chapter is devoted to the metallurgical treatment of zinc scrap, a subject which has heretofore received scant attention in the articles appearing in the technical

literature on the recovery of secondary metals. The large use of aluminum and its alloys gives the recovery of their metal scrap materials an importance which the author has also fully recognized in this book.

Since the type and design of the furnaces used in recovering secondary metals play such an important part in the general process, the author has devoted several chapters to a general discussion of the design and construction of reverberatory and crucible type furnaces as well as the various kinds of iron melting pots used in the recovery and refining operations.

A discussion of the various refractories used in furnace construction appears in a separate chapter. The recovery of flue dust, a frequently overlooked important metallic waste material, is given careful consideration in this book. There also is a brief description of the bonding materials and machines used in briquetting of this material, which process is commonly employed for agglomerating metal dust of this character. Considerable space is devoted to the sampling of scrap metals and residues in the latter part of the book. The American Standard Classification and the German Trade Standard Specifications for old metals, together with a number of tables giving useful data on the common non-ferrous metals, are also included.

To those engineers who classify all scrap metals as "junk," which through the devious processes of junk dealers and "back alley" refiners become secondary metals, to be viewed with suspicion and distrust, this work should come as an illuminating treatise. The large fund of information it contains will be just as valuable to those closely associated with the secondary metal trade.

For the Reference Shelf

A COMPREHENSIVE TREATISE ON INORGANIC AND THEORETICAL CHEMISTRY. Vol. X, Sulphur and Selenium. By J. W. Mellor. Longmans, Greene & Company, Ltd., New York, 1930. 958 pages. Price, \$20.

MELLOR'S TREATISE now lacks only three volumes for completion, so that in marveling at the unflagging output of the author, one is already thankful for the availability of such a broad work, written practically at one time. This tenth volume, appearing only a year after its predecessor and only eight years after the first of the series, contains the chemistry of sulphur and selenium. It is evident again that the word "comprehensive" used in the title has a real meaning: nothing seems to have been overlooked and copious references supplement the necessarily terse text. One can congratulate Dr. Mellor that, on his strenuous "travelogue" through the periodic system, he is rapidly approaching the borders beyond which there is no more.

TRATTATO DI CHIMICA GENERALE ED APPLICATA ALL' INDUSTRIA. Organic chemistry, 2nd part. Fourth edition. By Ettore Molinari. Ulrico Hoepli, Milano, 1930. Pages 660 to 1566.

IN THIS newly revised section of his justly appreciated book, Dr. Molinari includes oils, polyhydric alcohols, cyclic compounds, dyes, fibers, and proteins. It may be remarked that an English version of the third edition, published by P. Blakiston's Son & Company, Philadelphia, contains some newer material supplied by the original author and may be considered a close approach to the present volume. A series of extensive flow charts accompanies the Italian text.

Transportation Regulations

REGULATIONS for Transportation by Rail of Explosives and Other Dangerous Articles in Freight, Express, and Baggage Services; Including Specifications for Shipping Containers. Issued by the Interstate Commerce Commission. Published by the Government Printing Office, Washington, D. C. Price, 65 cents.

IN A new style and a new arrangement there has appeared a very fully revised edition of this document, which at last furnishes industry with an understandable and clear official statement of what may be shipped and how. The text rules are supplemented by splendid tabular summaries which greatly facilitate gathering of needed information on any particular commodity or with respect to any particular type of shipping container. Chemical engineers, especially those who are responsible only occasionally for making shipments of flammable, corrosive, or other chemicals, will welcome this new edition of the rules. As they use it they will find many occasions to thank the Commission, and particularly its specialist, L. I. Doyle, for the painstaking work which has been given to the task of simplifying and rewriting this valuable set of technical requirements.

Testing Refractories

PRÜFANSTALT FÜR FEUERFESTE MATERIALIEN. By L. Litinsky. Verlag von Otto Spamer. Leipzig, Germany, 1930. 127 pages.

WORKING on the impetus received by visits to numerous refractory laboratories throughout Germany, the author attempts to bring order into the varying practices by discussing the different commercial apparatus in conjunction with illustrations and the names of firms supplying them. He finds that there are 80 different laboratories in Germany alone testing refractories; there is much duplication, wasted effort, and verbal misunderstanding. His work, then, in no sense rivals that of standardization societies; in fact, it is in the hope of ultimately helping them that he attempts to inform testing engineers about their field in general. He purposely confines his scope to Germany and thus only incidentally calls attention to the work of the A.S.T.M.

Organic Chemical Catalysis

KATALYTISCHE REAKTIONEN IN DER ORGANISCH-CHEMISCHEN INDUSTRIE. Part I. By Horst Brueckner. Verlag Theodor Steinkopff, Dresden und Leipzig, 1930. 168 pages. Price, 16 M.

REVIEWED BY J. S. STREICHER

WITHIN the last ten years systematic research on catalysis in organic chemistry has produced very many new and unexpected results. Many branches of chemical industry went through a kind of revolution by this development. But the data on this research are scattered through all branches of chemical literature, mostly hidden within patents.

The author here gives a very thorough survey of this important development, the facts being classified within the following chapters: (1) Development of the concept of reaction velocity, catalysis, and catalysts; industrial catalytic processes; (2) preparation of catalyzers; (3) purification of the gases used in large-scale catalytic

processes; (4) negative catalyzers and their use in organic chemical industry; (5) catalytic processes of oxidation; (6) hydrogenation processes; (7) dehydrogenation.

In every chapter extensive author indexes are given to find the original research work. At the end of the book is a list of patents, arranged according to countries. This little book shows how much work can still be done with this new development in chemical industry: wherever it is the center of interest in organic processes, the facts compiled here will give useful information.

Plant Handbooks

PIPING HANDBOOK. By *J. H. Walker* and *Sabin Crocker*, with contributions by others. McGraw-Hill Book Company, New York, 1930. 763 pages. Price, \$5.

TO MOST engineers, there can be no such thing as too many handbooks. The "Piping Handbook," with its attractive flexible binding, will be a welcome newcomer on the "active" shelf of every engineer who must face the multitudinous problems that piping involves. Lacking the unfriendly terseness usually associated with its kind, it is more conversational and hence more readable. It is less, "Do this, do that," and more "Try this way," proving itself to be right at frequent intervals by propounding a question and then solving it neatly. It offers many examples, together with several hundred tables, charts, formulas, and illustrations. The 217-page section on fluids is an outstanding feature of the book.

THE WELDING ENCYCLOPEDIA, Seventh Edition. Edited by *L. B. Mackenzie* and *H. S. Card*. Welding Engineer Publishing Company, Chicago, 1930. 542 pages.

AUTOGENOUS welding from "Abbott Joint" to "Zerener Process" is the accomplishment of the first or encyclopedic section of the Handbook, occupying about 45 per cent of its space. The remaining 55 per cent is given over to separate chapters on the principal types of autogenous welding, on the welding of various forms of structure and container, on training operators, rules and regulations governing the use of welding; and to a section on charts and tables covering in detail temperatures, gages, properties of metals, and forms of welded joint. The book is of value not only to the welder himself but to the designer or chemical engineer who must today use welding in his business.

Recently Arrived

THE GEORGE FISHER BAKER NON-RESIDENT LECTURESHIP IN CHEMISTRY, Cornell University. By *F. M. Jaeger*. McGraw-Hill Book Company, New York, 1930. 450 pages. Price, \$4.—Delivered early in 1929, these lectures deal with special arrangements of atomic systems, precise measurements at high temperatures, and constitution and structure of ultramarines.

GENERAL CHEMISTRY FOR COLLEGES. By *B. Smith Hopkins*. D. C. Heath & Company, New York, 1930. 757 pages. Price, \$3.72.—This replete addition to a not altogether sparse field should rank high among its group, especially for the man who wants to refresh himself on details of general chemistry after years of formal study. It is well illustrated and gives a commendable amount of attention to industrial practice.

TECHNICAL CHEMISTS' HANDBOOK. By *George Lunge* and *A. C. Cumming*. Third edition. Gurney & Jackson, London, England, 1929. 262 pages.—The revised edition of this useful little industrial handbook consists mainly of recalculated tables and a slight expansion.

TASCHENBUCH FÜR DIE ANORGANISCH-CHEMISCHE GROSS INDUSTRIE. By *G. Lunge* and *E. Berl*. Seventh edition. Julius Springer, Berlin, Germany, 1930. 402 pages. Price, 37.50 M.—The German version of Lunge's handbook is already in its seventh edition and in two parts, the second of which consists of 31 nomogrammic tables, for various standard calculations in chemical plants.

METALLOGRAFIE DER TECHNISCHEN KUPFERLEGIERUNGEN. By *A. Schimmel*. Julius Springer, Berlin, Germany, 1930. 140 pages. Price, 20.50 M.—The metallography of various copper alloys presented in a text with numerous photographs and a colored chart. An excellent specimen of printing.

PERIODISCHES SYSTEM. By *E. Rabinowitsch* and *E. Thilo*. Ferdinand Enke Verlag, Stuttgart, Germany, 1930. 302 pages.—A highly scientific and thorough study of the theories arising from the periodic system.

PRINCIPLES AND PRACTICE OF FLOW METER ENGINEERING. The Foxboro Company, Foxboro, Mass., 1930. 247 pages. Price, \$2.—A fundamental study of flow measurements largely colored by the company's industrial experience, whose engineers have done much of the original work on the subject. It is hence authoritative and indicative of current practice.

GMELINS HANDBUCH DER ANORGANISCHEN CHEMIE EISEN: Teil B, 2 and 3. Verlag Chemie, G.m.b.H., Berlin, 1930. 200 and 143 pages. Price: 25 M. and 19 M. (In subscription).—Further continuation of the new section on iron, including the salts of the halogens, sulphur oxides and carbon combinations.

A LABORATORY MANUAL OF QUALITATIVE ANALYSIS. By *Frederick W. Miller*. The Century Company, New York, 1930. 233 pages. Price \$2.—The usual procedures illustrated with photographs, charts, and examples.

GERMAN FOR CHEMISTS. By *Louis deVries*. The Chemical Publishing Company, Easton, Pa., 1929. 180 pages.—A reading selection from the works of famous German chemists, covering various phases of chemistry and hence designed to be informative as well as educational. It contains a glossary, and is to be recommended for training in technical German.

PROPERTY AND NUMERICAL RELATIONSHIP OF THE COMMON ELEMENTS AND COMPOUNDS. By *J. E. Belcher* and *J. C. Colbert*. The Century Company, New York, 1930. 160 pages. Price, \$1.75.—Contains directions for 67 experiments, providing essential primary laboratory work. For use with a standard text.

Industrial Laboratory Directory

THE Research Information Service of the National Research Council is preparing a revision of its "Industrial Research Laboratories of the United States, including Consulting Research Laboratories," the third edition of which was published in 1927. According to Clarence J. West, the director, up to the present some 1,250 firms have been listed as maintaining research or development laboratories. However, since it is felt that some of the companies falling into this classification may have been overlooked, it is urged that any who have not yet received questionnaires apply for them at the Research Information Service, National Research Council, Washington, D. C. The listing in the revised edition involves no financial obligation on the part of the firm; but in the interests of completeness, as well as the potential value of the listing, the slight co-operation involved should certainly be repaid by the usefulness of the directory.

SELECTIONS FROM RECENT LITERATURE

APPARATUS FOR NITRATING CELLULOSE. Vaube. *Nitrocellulose*, April, pp. 26-8; August, pp. 121-2. The Thompson process for nitrating cellulose in open stoneware vessels has not met with much success, partly because the apparatus is fragile. The centrifugal method is the most common, but is meeting serious competition from modernized forms of the older and less efficient nitrating pot. The newer nitrating kettles, equipped with mechanical agitators, are arranged to discharge into a centrifuge, which is not the same as a nitrating centrifuge. It is claimed for the nitrating kettle that it carries less fire hazard than does the nitrating centrifuge; and this may be true to the extent that there is more safety in carrying on the nitration separately from the centrifuging. The kettle is preferable from the operator's standpoint, since operating a nitrating centrifuge is hard, exacting work, and is further complicated by the necessity of wearing a gas mask. Charging and discharging are relatively easier and quicker when a nitrating kettle is used. But separating the operations also has its drawbacks. It requires two pieces of equipment instead of one, and four drives instead of the single drive which suffices for one or several centrifuges. Moreover, when the kettles are used in groups, a breakdown of one necessitates a shutdown of the entire group, whereas in a battery of centrifuges when one is stopped the others function as usual. Other relative merits of the two nitrating methods are discussed, and drawings are shown of modern nitrating kettles.

NICKEL MOLYBDENUM CATALYST. E. Keunecke. *Zeitschrift für Elektrochemie*, September: pp. 690-2. For reasons which are not certainly known, nickel and its two congeners, iron and cobalt, stand out from other metals in that their catalytic activity is greatly increased by molybdenum in ammonia synthesis. Nickel is particularly useful in the molybdenum combinations; the iron and cobalt catalysts show some deviations from the rule of activation by molybdenum. It has been observed that prolonged catalytic activation is obtained only in mixtures containing (in the case of nickel) 62 per cent or more of molybdenum, and that these contact masses always contain nitrogen combined with molybdenum, in addition to the compound NiMo. No free nickel was detected in these catalyst masses. Since NiMo by itself is not an active catalyst for ammonia synthesis, it appears probable that the active component of these mixtures is the compound of nitrogen with molybdenum, and that it is activated by NiMo. That is, the NiMo has a function similar to that of aluminum oxide or the iron-aluminum spinel in the iron oxide-clay activated

catalysts. As with other catalysts, mode of preparation has a great influence; for example, formation of NiMo (or of mixed crystals of nickel and molybdenum) is accelerated by heating in vacuum or in an atmosphere of nitrogen-free hydrogen.

COLEY PROCESS FOR ZINC. *Industrial Chemist*, September; pp. 357-60. The Coley process, depending on the reducing action of nascent carbon to extract zinc metal from oxide and carbonate ores, has also been successfully applied to tin and apparently could be profitably used for several other metals. The nascent carbon is derived from the cracking of petroleum; at or just prior to its deposition this carbon is extremely active and is chemically much more effective than ordinary activated carbon. Development work on the process began in 1922, with experiments on iron; but the iron thus formed was not in suitable physical state for further working. Trials with other ores led to the application of the process to zinc production. At the optimum temperature the reduction is very rapid and complete; and the reaction is selective, if performed with adequate temperature control, because each metal has its own characteristic optimum reduction temperature. Either low- or high-grade ores can be profitably treated; in fact, it is not yet certain which is preferable over a long term of operation. Of the zinc present in the ore, about 95 per cent is recovered as a black powder, containing some carbon. This powder yields about 80 to 85 per cent of its zinc as ingots, the remainder being returned for re-treatment. A new plant is being built in Tunis to operate on the abundant but low-grade Tunisian calantine ores.

ELECTRIC DISCHARGE REACTIONS. E. Briner and B. Susz. *Helvetica Chimica Acta*, July; pp. 678-95. With the aid of a calorimeter attachment and an electrical instrument for measuring power factor, a study has been made of the factors governing yields in chemical reactions effected with the aid of electric discharge. Taking ozone production as the test reaction, measurements were made of the effects of gas flow, pressure, and temperature. It was found that low pressure and very low (liquid air) temperature greatly facilitate the reaction. Under favorable conditions, energy yields as high as 246 g. per kilowatt-hour were attained. In terms of conversion of electrical into chemical energy, this represents a yield of about 20 per cent, a great increase over the 3 or 4 per cent which characterize the commercial production of ozone in ozonizers of the electric discharge type. Tables and curves are given, showing the experimental data from measurements of the effects of temperature,

pressure, and other factors on electric discharge reactions. It is believed that these results have some significance in connection with the reactions in which there is actual or potential use for the electric discharge method on an industrial scale.

STRENGTH OF FIREBRICK BONDS. W. E. Patterson and C. C. Weeks. *Canadian Chemistry and Metallurgy*, September; pp. 253-6. Among the leading requirements for satisfactory bonding of firebrick in high-temperature plants are high tensile strength and wide temperature range of bonding. A comparison has therefore been made of bonding materials now in industrial use, including the three types: fireclays, dry high-temperature cements, and wet high-temperature cements. Industry is slow to change from fireclay bonds to the high-temperature cements, although there is an accumulation of evidence of the relative inferiority of the fireclays. The measurements here reported add to this evidence, in that they show for the high-temperature cements a much greater bonding power under actual operating conditions, and a much wider temperature range within which good bonding can be achieved. Another difference is that fireclays suffer much more shrinkage when fired, sometimes as high as 38 per cent, whereas shrinkage did not exceed 2 per cent with the high-temperature cements. Excessive shrinkage fosters interior erosion, and decreases efficiency of operation on account of air or fume leakage. With respect to bonding strength, comparative tests at the surface and 2 in. inside a boiler pit wall showed that fireclay bonds either lost strength or gained none, whereas the high-temperature cements were even stronger in the interior than at the surface.

MIXED CATALYSTS. A. Mittasch. *Zeitschrift für Elektrochemie*, September; pp. 569-80. There has been a considerable development in the compounding and use of mixed catalysts, and much greater advances may be expected, because this is a complex field with many possibilities as yet unworked. Some of the most important of the early developments were in connection with ammonia synthesis; out of this grew other commercial applications, including hydrogenation with the aid of nickel-and-clay catalysts and synthesis of methanol and other compounds by high-pressure catalytic hydrogenation of the oxides of carbon. The successful use of osmium and alkali in ammonia catalysis is an outgrowth of an observation, made in 1910, that the catalytic effect of osmium was enhanced by alkalis. The true mechanism of this particular case of activation is still uncertain, but it seems probable that the effect is one of

chemical energetics. The relations are still more complex in the ternary and quaternary catalyst mixtures, in which it is nevertheless possible in some cases to allot empirically a specific function in the reaction to each component.

CENTRIFUGE TESTS. G. Oehler. *Chemische Fabrik*, July 9; pp. 265-6. A comparison is made, on the basis of mathematical and physical reasoning, of the centrifugal effect obtainable in horizontal and vertical centrifuges. Equations are derived, from which the speed for a given basket (or the basket height for a given speed) can be calculated at which the contents will

overflow in a horizontal centrifuge. Flanged centrifuge baskets are considered in connection with the overflow problem. Equations also are derived for the parabolic flow in a vertical centrifuge, taking into account the gravity and centrifugal components. Results of practical tests with both types of centrifuge are reported, and illustrated with data tables and curves. Contrary to current opinion, the vertical construction does not give a better centrifugal effect than the horizontal construction. The effect with horizontal centrifuges is at least equal to that obtained in a vertical machine, if not actually greater.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from the bureau responsible for its issue.

Copper Electrotyping. Bureau of Standards Circular 387. 10 cents. An elementary scientific review.

Italian Chemical Developments in 1928 and 1929, by Elizabeth Humes. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 705; 10 cents.

The Czechoslovak Iron and Steel Industry, by Karl L. Rankin. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 713; 10 cents.

The Chemical Industry in Czechoslovakia, by William T. Dougherty. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 708; 10 cents.

Naval Stores Statistics for 1929, reported by Department of Agriculture. Mimeographed statement from Bureau of Chemistry and Soils.

Italian Sulphur Pyrites and Sulphuric Acid, by H. O. Moraw. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 318; mimeographed.

Formulae for Completely and Specially Denatured Alcohol. Bureau of Prohibition Appendix to Regulations No. 3 (formerly 61), revised June, 1930; 5 cents.

Commerce Yearbook, 1930. Vol. I—United States. Issued by the Department of Commerce; \$1. Contains detailed information concerning business conditions in the United States.

Biennial Census of Manufactures, 1927. Bound volume issued by Department of Commerce; \$2.25.

Mineral Resources Statistics From the Bureau of Mines. Printed pamphlets for 1928 operations on Coke and Byproducts, 15 cents; Petroleum, 15 cents; and Lead, 10 cents; and for 1929 operations on Fuel Briquets, 5 cents; Fluorspar and Cryolite, 5 cents; and Arsenic, 5 cents. Preliminary

mimeographed statements for 1929 on lime; barite and barium products; phosphate rock, chromite; Pennsylvania anthracite; Portland Cement, mica; secondary metals; stone; and byproduct coke byproducts. The printed 1929 summary for all industries is also available at 20 cents.

Census of Manufactures for 1929—preliminary mimeographed statistics for: Fireworks; carbon paper and inked ribbons; bluing; crucibles; cast-iron pipe and fittings; sand-lime brick; pottery; tanning materials, natural dye-stuffs, mordants and assistants, and sizes; ammunition and related products; wall paper; cork products; linseed oil, cake, and meal; pyroxylin plastics; aluminum manufactures; flavoring extracts and flavoring sirups; malt; chewing gum; baking powders, yeast, and other leavening compounds; corn sirup, corn oil, and starch; cereal preparations; macaroni, spaghetti, vermicelli, and noodles; beet sugar; cane sugar; and cane-sugar refining.

Mineral commodity studies—economic and technical information is summarized by the Bureau of Mines in its mimeographed Information Circulars on the following raw materials and their principal industrial uses: Radium, by Paul M. Tyler, I.C. 6312; Marble, by Oliver Bowles and D. M. Banks, I.C. 6313; Selenium and Tellurium, by R. M. Santmyers, I.C. 6317; Monazite, Thorium, and Cerium, by R. M. Santmyers, I.C. 6321; Tantalum (and Columbium), by E. P. Youngman, I.C. 6328; Sulphur, by Robert H. Ridgway, I.C. 6329; and Cobalt, by Paul M. Tyler, I.C. 6331.

Survey of Cracking Plants, Jan. 1, 1930, by G. R. Hopkins. Bureau of Mines Information Circular 6305. A mimeographed directory of the industry.

Flotation Reagents, 1928, by T. H. Miller and R. L. Kidd. Bureau of Mines Report of Investigations 3004; mimeographed.

Natural-Gasoline Plants in the United States, Jan. 1, 1930, by G. R. Hopkins and E. M. Seeley. Bureau of Mines Information Circular 6279. A mimeographed directory of the industry.

Increased Recoveries of Phosphate in the Land-Pebble District of Florida, by H. M. Lawrence. Bureau of Mines Report of Investigations 3023; mimeographed.

Gravity Concentration on Certain Florida Phosphatic Sands, by R. M. Lawrence and R. G. O'Meara. Bureau of Mines Report of Investigations 3018; mimeographed.

Flammable Gas Safety Reports. Bureau of Mines mimeographed documents include: the following Reports of Investigations: R.I. 3017, A New Flame Safety-Lamp Testing and Demonstration Apparatus; R. I. 3008, Laboratory and Field Tests of a Permissible Indicating Methane Detector; R. I. 3027, Acrolein as a Warning Agent for Detecting Leakage of Methyl Chloride From Refrigerators; and R. I. 3016, The Lower Limits of Inflammability of Natural Gas-Air Mixtures in a Large Gallery.

Zinc Smelting From a Chemical and Thermodynamic Viewpoint, by C. G. Maier. Bureau of Mines Bulletin 324; 20 cents.

Dissolution of Various Manganese Minerals, by C. W. Davis. Bureau of Mines Report of Investigations 3024; mimeographed.

A Survey of the Sulphur Content of Commercial Motor Fuels—1930, by A. J. Kraemer. Bureau of Mines Report of Investigations 3026.

A Study of the Lubricant Fractions of Cabin Creek (W. Va.) Petroleum, by H. M. Smith and others. Bureau of Mines Technical Paper 477; 15 cents.

The Recovery of Oil From Sands by the "Gas Drive," by Joseph Chalmers and others. Bureau of Mines Report of Investigations 3035.

Lime-Sulphur Concentrate—Preparation, Uses and Designs for Plants, by E. H. Siegler and A. M. Daniels. U. S. Department of Agriculture Farmers' Bulletin 1285.

Procedure for Testing Explosives for Permissibility for Use in Coal Mines, With Test Requirements, Tolerance Limits, and the Schedule of Fees. Bureau of Mines Schedule 17B.

Stock Distribution and Gas-Solid Contact in the Blast Furnace, by C. C. Furnas and T. L. Joseph. Bureau of Mines Technical Paper 476; 30 cents.

Some Hazards of Transporting Explosives in Automobile Trucks, by C. W. Owings and J. M. Harrington. Bureau of Mines Information Circular 6330; mimeographed.

Check Determinations of the Fusibility of Coal Ash With the DeGraaf Electrical Coal-Ash Fusion Furnace, by W. A. Selvig. Bureau of Mines Report of Investigations 3003; mimeographed.

THE PLANT NOTEBOOK

Freezing Liquids in Pipes Simplifies Repairs

By W. M. LAUGHTON
Drylce Corporation of America
New York

FREQUENT REVISIONS and repairs of chemical plant piping require the use of more valves for cut-off purposes than most other plants, and these are almost sure causes of leakage and trouble. The removal of many of these is simplified by a new method of blocking sections of pipe that require repair, by freezing with solid carbon dioxide, a method that has been very successfully applied in handling water system problems.

At the temperature of solid carbon dioxide (-109.6 deg. F.) even large water mains can be easily frozen and completely blocked through its use, even when under ordinary water pressure. In the same way, lines carrying many other liquids, including practically all water solutions, the common acids, and most of the other liquids usually handled in chemical plants may be temporarily blocked by freezing. There are, of course, exceptions. Alcohol, ether, acetone, and a few other solvents cannot be frozen in this way.

Freezing is accomplished by packing a quantity of solid carbon dioxide, either cut or broken into pieces of convenient size, around the pipe on each side of the proposed break in such a way as to maintain maximum heat transfer contact. After the work has been done, only a short time is required to allow the pipe to thaw and resume service.

This method can be applied to lines still in service and the shut-off is practically no longer than is required to make the repair itself. No case of a burst pipe has been observed in the several years that such freezing has been in use in plumbing practice on wrought and cast-iron pipe containing water.

How much solid carbon dioxide will be required for any particular job naturally varies rather widely, depending on the pipe size, required temperature, time and other obvious factors, but in general the cost of the method has been found to be very low when time of shut-down is an important item.

Sampling Thickeners

ACCURATE sampling of thickeners and other tanks containing suspended solids is easily accomplished, according to *Engineering & Mining*

Journal, by means of a length of pipe over the lower end of which a few inches of rubber hose is slipped. A cord attached to one side of the hose is threaded through a hole in the other side, so that when the cord is pulled, the hose folds upward and seals the pipe. By this means it is possible to obtain a representative sample of every level in the tank to within a very short distance of the bottom. It is hence an improvement since most samplers permit sampling only of a short vertical interval.

Area of Drill Size Holes

By L. COON
Draftsman, Kellogg Mfg. Company
Rochester, N. Y.

AMONG the many catalogs and books through which I have searched, I have never been able to find a data sheet on the area of drill-size holes. In the course of time I worked out a table covering the dimensioned, lettered, and numbered drill sizes, 137 of them, ranging from 0.5 to 0.0135 in. in diameter. In the belief that these should be of value to those who deal with and design equipment for handling gases and vapors, the data are reproduced in the table below.

AREA OF DRILL SIZE HOLES

Size	Decimal Equivalent	Area	Size	Decimal Equivalent	Area	Size	Decimal Equivalent	Area	Size	Decimal Equivalent	Area
1/2	0.500	0.1964	G	0.261	0.0534	23	0.154	0.0186	1/16	0.0625	0.0031
31/64	0.4843	0.1839	F	0.257	0.0518	24	0.152	0.0181	53	0.0595	0.0026
15/32	0.4687	0.1762	E, 1	0.250	0.0491	25	0.1495	0.0174	54	0.055	0.0023
29/64	0.4531	0.1611	D	0.246	0.0471	26	0.147	0.0169	55	0.052	0.0021
7/16	0.4375	0.1503	C	0.242	0.0459	27	0.144	0.0162	56	0.0468	0.0016
27/64	0.4218	0.1391	B	0.238	0.0444	9/64	0.1406	0.0153	58	0.0465	0.0016
Z	0.413	0.1343	15/64	0.2343	0.0430	28	0.1405	0.0153	57	0.043	0.0014
13/32	0.4062	0.1296	A	0.234	0.0430	29	0.135	0.0142	58	0.042	0.0013
Y	0.404	0.1281	1	0.228	0.0408	30	0.1285	0.0128	59	0.041	0.0012
X	0.397	0.1237	2	0.221	0.0383	1/8	0.125	0.0123	60	0.040	0.0012
25/64	0.3906	0.1193	7/32	0.2157	0.0376	31	0.120	0.0113	61	0.039	0.0011
W	0.386	0.1169	3	0.213	0.0356	32	0.116	0.0105	62	0.038	0.0010
V	0.377	0.1116	4	0.209	0.0343	33	0.113	0.0099	63	0.037	0.0010
U	0.375	0.1105	5	0.2055	0.0329	34	0.111	0.0096	64	0.036	0.0009
23/64	0.368	0.1063	6	0.204	0.0326	35	0.110	0.0095	65	0.035	0.0009
T	0.3593	0.1011	13/64	0.2031	0.0323	7/64	0.1093	0.0093	66	0.033	0.0007
S	0.358	0.1006	7	0.201	0.0317	36	0.1065	0.0088	1/32	0.0312	0.0007
11/32	0.348	0.0951	8	0.199	0.0311	37	0.104	0.0084	67	0.032	0.0007
R	0.3437	0.0928	9	0.196	0.0301	38	0.1015	0.0080	68	0.031	0.0007
Q	0.339	0.0902	10	0.1935	0.0292	39	0.0995	0.0076	69	0.029	0.0006
21/64	0.332	0.0865	11	0.191	0.0285	40	0.098	0.0075	70	0.028	0.0005
P	0.3281	0.0844	12	0.189	0.0280	41	0.096	0.0072	71	0.026	0.0005
O	0.323	0.0819	3/16	0.1875	0.0274	3/32	0.0937	0.0067	72	0.025	0.0004
5/16	0.3125	0.0784	13	0.185	0.0268	42	0.0935	0.0067	73	0.024	0.0003
N	0.302	0.0767	14	0.182	0.0260	43	0.089	0.0062	74	0.0225	0.0003
19/64	0.2968	0.0716	15	0.180	0.0254	44	0.086	0.0057	75	0.021	0.0003
M	0.295	0.0688	16	0.177	0.0245	45	0.082	0.0052	76	0.020	0.0003
L	0.290	0.0663	17	0.173	0.0234	46	0.081	0.0051	77	0.018	0.0002
9/32	0.2812	0.0621	11/64	0.1718	0.0229	47	0.0785	0.0047	1/64	0.0156	0.0002
K	0.281	0.0619	18	0.1695	0.0223	5/64	0.0781	0.0044	78	0.016	0.0002
J	0.266	0.0592	19	0.166	0.0215	48	0.076	0.0042	79	0.0145	0.0001
I	0.272	0.0570	20	0.161	0.0203	49	0.073	0.0038	80	0.0135	0.0001
H	0.266	0.0555	21	0.159	0.0197	50	0.070	0.0036			
17/64	0.2656	0.0551	22	0.157	0.0193	51	0.067	0.0034			
			5/32	0.1562	0.0192	52	0.0635	0.0032			

(Chem. & Met., October, 1930)

EQUIPMENT NEWS

FROM MAKER AND USER

Mercury Arc Rectifiers for Electrolytic Work

USE of mercury arc rectifiers for the production of current in electrolytic operations is not a particularly recent development, but it is only within the last few months that this type of rectifier has been able to handle large current capacities. Recent information from the American Brown Boveri Company, Camden, N. J., indicates that such rectifiers have now developed to a point where a capacity of 10,000 amp. for a rectifier is not uncommon. In 1921 Brown Boveri made the first electrolytic installation of mercury arc rectifiers. It consisted of three 430-volt rectifier sets with a total capacity of 700 kw. They were purchased by the Selsa Works at



Three 10,000-Amp., 650-Volt, Mercury Arc Rectifiers in Electrolytic Zinc Plant of Consolidated Mining & Smelting Company

Bodio, Switzerland, and were used for the electrolytic production of hydrogen. In 1925 the first installation for the manufacture of chlorine was made at the Consolidated Alkali Works at Westeregeln, Germany.

Since these early installations, extensive research has made it possible to build rectifiers for much heavier current. The losses in a mercury arc rectifier are independent of the d.c. voltage. Efficiency, therefore, increases with the d.c. voltage. And since the current rating is also practically independent of the d.c. voltage, it naturally follows that the higher the latter, the higher the kw. rating, and the lower the cost per kilowatt. For d.c. voltages of 400 to 600 volts, the rectifier efficiency is approximately equal to the efficiency of synchronous converters or motor-generators, and above 600 volts, the rectifier is said to be more efficient.

The advantages claimed for such rectifiers include impossibility of polarity reversal, lower installation cost, lower weight and maintenance than with other rectifiers, and simpler construction.

Recent installations of mercury arc

rectifiers include a 6,000-amp. 360/500-volt rectifier for chlorine production in Germany; three 5,000-amp. 430/570-volt rectifiers for hydrogen production in Poland; and three 10,000-amp., 650-volt rectifiers used in the plant of the Consolidated Mining & Smelting Company, Trail, B. C., for electrolytic zinc. This company has on order three additional rectifiers of the same size to be used in making hydrogen for the company's new synthetic ammonia plant.

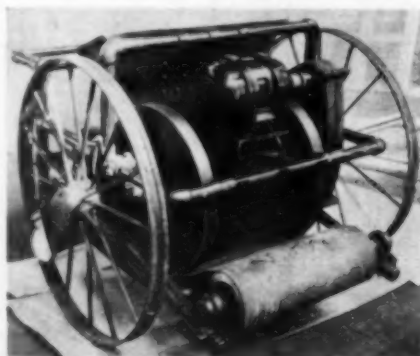
Small Electric Crane

INDIVIDUAL drive for its four-wheels and a consequent small turning radius, is a feature of a new crane which has been placed upon the market by the Terminal Engineering Company, 17 Battery Place, New York. The crane capacity is 3,650 lb. at a distance of 2 ft. from the end of the chassis and 750 lb. at a distance of 14 ft. from the end of the chassis. The boom is telescopic over a distance of 6 ft. Maximum height of lift is 17½ ft., although longer special booms may be furnished. Turning radius is 5 ft. 3 in. The capacity of the storage battery which operates both crane and wheel motors is said to be sufficient to operate an electric lift magnet.

Heavy-Duty Loader

AN ACCOMPANYING illustration shows a new heavy-duty box-car loader for bulk materials such as fertilizer or stone, which has recently been announced by the Stephens-Adamson Manufacturing Co., Aurora, Ill. This is a modification of the company's standard box-car loader, and operates by means of a high-speed belt which, during a certain part of its travel, is forced by two disks to move in the arc of a circle. Material deposited from a

Heavy-Duty Loader of the "Slinger" Type



New MAG Pulverizer Features One-Piece Rotating Element

feed hopper on the belt is thus held against it by centrifugal force to assist it in reaching the belt speed before it is projected from the head pulley.

The new machine uses a 30-in. belt with a speed of 2,000 ft. per minute. It has a capacity of 300 tons per hour using a 7½-hp. motor, and 400 tons per hour with a 10-hp. motor, and yet it can be handled by one man. The maximum lump size is 6 in. and the average trajectory height, 9 ft. The throwing distance is about 38 ft. Features of the machine include anti-friction bearings of dust-proof construction, and high-pressure lubrication.

Disk Type Pulverizer

ONE-PIECE construction of the disk which carries the pulverizing blades is a feature of the new MAG pulverizer, which has recently been placed upon the market by the Maschinenfabrik A.-G., of Geislingen-Steige, Germany. This pulverizer, shown in the accompanying view, is of the type in which a rotating disk carrying blades operates in conjunction with a stationary element, also carrying numerous blades between which the material is crushed. Crushed material is forced through a screen which surrounds the pulverizing element. The machine is shown in the accompanying view.

The rotating element is cast of one piece of manganese steel without separate blades. Material enters at the center of the disk, and through the action of the blades is spread equally over the surface of the pulverizing rings, is pulverized by impact and centrifugal force, and then passes at great speed, under the action of the air

current set up by the disk, through the rings and the screens. This fan action is said effectively to cool the material.

The pulverizer is designed for soft and medium hard materials and is said to have a capacity greater than other machines of equal size. Dust-collecting and ventilating equipment for use with it are available.

Remote Manual Control

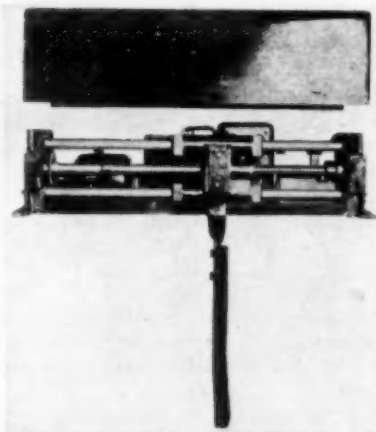
OPERATION of valves at a distance under the complete control of the operator is now possible through the use of the De Florez remote control system, which has recently been introduced by the Brown Instrument Company, Philadelphia, Pa. In most remote control valves, the operation of a pushbutton at the control station fully opens or closes the valve. In the De Florez valve, the operator turns a handwheel, and through the use of an electrical power transmission system, the wheel of the valve follows this accurately. The transmission system is such that only the amount of power applied to the handwheel is actually transmitted to the valve and hence any obstruction or sticking of the valve is felt by the operator.

The accompanying drawing shows the principal parts of this system. The handwheel at the control station is connected through gearing to the armature of a General Electric self-synchronous alternating-current motor (Selsyn motor). The number of turns of the handwheel is indicated on a turn indicator. A pilot light above the turn indicator indicates whether or not power is connected to the Selsyn motor circuit.

By a special type of connection between the fields of the sending and receiving Selsyn motors, any rotation of the sending armature is accurately reproduced by the receiving motor. Motion of the receiving motor is then transmitted through gearing and a flexible link to the valve operating mechanism, which comprises a worm gear attached by a clutch to the handwheel of the valve so that manual operation is possible in the event of power failure. The flexible connection makes it possible to use the same mechanism either for rising-stem or stationary-stem valves. The gearing

at the receiving end may either reproduce the motion of the sending end, turn for turn, or it may be in some fixed ratio to the former to make control more sensitive or to permit the movement of very large valves.

This system is at present used in oil refining and appears to have many other applications. Valve control for an entire plant may be centralized through its use, according to the manufacturer. Transmitting units are made up in small panels approximately 16x30 in. for ready assembly in batteries.



With Cover Removed Showing Transmission Mechanism and Cutter

Automatic Sampler

METALLURGICAL industry is responsible for the development of an automatic sampler which is now available for use in chemical engineering plants. This machine, with the type of cutter ordinarily used for wet, and for some dry materials which flow readily, is shown in the accompanying halftone. The device, known as the Geary-Jennings sampler, is offered for sale by the Galigher Company, Salt Lake City, Utah.

The machine consists of a sample cutter suspended from a crosshead which slides on two upright rods. The crosshead is bored and tapped to receive a threaded shaft, the rotation of which propels the cutter across the pulp stream to be sampled. The shaft is driven by a small motor through a chain- and-sprocket drive of the automotive timing-chain type. The motor is reversible and operates intermittently, its operation being controlled by a standard adjustable electric timing switch.

In operation, the sampler is installed at the discharge of a conveyor, launder, or chute, so that the material falls against the cutter during its travel. Material which is thus trapped slides

down the cutter and away from the main stream of the material, falling into any suitable sample container. The sampling period may be varied between 2 seconds and 36 minutes, and a number of samplers may be operated simultaneously by a master timing switch.

New Silicon Bronze

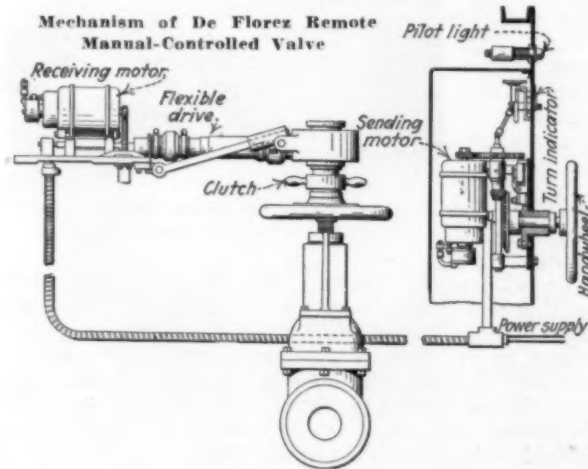
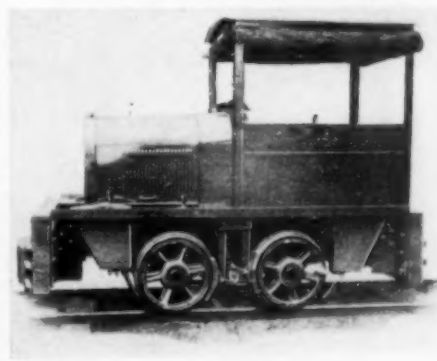
SHEET, strip, rod, and wire are the forms in which a new high-strength silicon bronze, known as "Duronze," has been put upon the market by the Bridgeport Brass Company, Bridgeport, Conn. Although the new alloy is not designed as an acid-resisting material, its corrosion resistance is said to be better than brass or copper, and the manufacturer states that it is standing up very well in dilute sulphuric and hydrofluoric acids. Its resistance to atmospheric corrosion is said to be excellent. It does not crack under the action of ammonia gases, which seriously injure brass and nickel silver. It does not become brittle in mercurous nitrate solution. Mine waters and sodium sulphite solutions are among the materials to which it is said to be resistant.

When fully annealed, the alloy has a tensile strength of 42,000 lb. per square inch. Cold-drawing, which does not make it brittle, develops a strength of approximately 135,000 lb. per square inch. Rod is obtainable in a strength of 100,000 lb. per square inch. The metal is said to be readily workable either hot or cold. It is further claimed to be proof against season and corrosion cracking when exposed to weathering. Its machining properties, according to the manufacturer, are better than those of phosphor bronze and many acid-resisting alloys. Its weight is approximately 1 per cent less than copper.

Gasoline Industrial Locomotive

AFORD truck power plant is being used to supply the motive force in two new series of industrial locomotives of 2-, 2½-, 3-, 3½-, and 4-ton sizes, announced by the Brookville Locomotive Company, Brookville, Pa. The entire power plant, including the clutch and transmission, are used without alteration, resulting, it is said, in easy

Ford Powered Industrial Locomotive



maintenance through the service of Ford dealers.

Locomotive frames are of structural steel. The drive is through short, over-size chains. The special reversing gear provided is said to be exceptionally strong. Renewable steel tires are provided on the wheels. In all models there are four speeds both forward and reverse. Cabs are available as standard equipment together with self-starting equipment.

One-Way Clutch

"Revocentric" variable speed reducer,

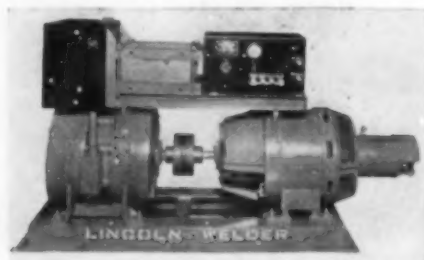
IN ITS FEBRUARY, 1930, issue, *Chem. & Met.* described the made by the Universal Gear Corporation, 347 South La Salle Street, Chicago, Ill. This company now announces the separate production of one important part of the speed reducer, known as the Pitter clutch. This style of clutch is used in the reducer to transmit motion to the output side from a variable-throw eccentric. The clutch, as now produced separately, is intended for all applications where it is desired to convert alternating motion into one-way movement.

Reference to the above mentioned article will show the principle of the clutch. It consists of a number of shoes supported between two concentric rings in such a way that free motion of one ring with respect to the other is permitted in one direction but prevented by the wedging action of the shoes in the other direction. The manufacturer states that no power is transmitted by the pins or links which hold the shoes in place, all power being transmitted directly from the inner to the outer ring through the shoes themselves.

New Welding Equipment

FOR FABRICATION of light material, Lincoln Electric Company, Cleveland, Ohio, announces a new electrode known as "Lightweld." This electrode can be used on 16- to 22-gage metal in making lap, butt, or corner welds, and is said to give a dense weld free from pinholes. It is used with a manual carbon arc and 30 to 60 amp. direct current. The rod is $\frac{1}{8}$ in. in diameter and 30 in. long. It is claimed that speeds of from 7 to 18 in. per minute, depending upon the type of joint and other factors, may be attained with the new rod.

New Stable-Arc Welder Rated at 600 Amp.



At the other extreme in welding, the company has placed on the market a new heavy-duty welder, with a rating of 600 amp. and a current range from 180 to 750 amp. This is shown in the accompanying illustration to be a motor-driven, single-operator, variable-voltage machine in which the motor and generator are direct-connected. This is made in the stationary truck type, as shown in the illustration, or in a portable truck type. A simple unified control is mounted above the motor generator. Features include the use of a rugged volt-ammeter, and wing-nut terminals to facilitate connections and reversing of polarity.

Copper-Lead Bearing Metal

"KALIF," a uniform alloy of copper and lead, has recently been introduced by the Kalif Corporation, Emeryville, Calif. The metal melts at 952 deg. C. and has a tensile strength at 21 deg. C. of 10,000 lb. per square inch. At 105 deg. C., the strength is 7,100 lb. and at 213 deg., 5,360 lb. Brinell hardness at 21 deg. C. is 28. Bearings are supplied centrifugally cast, reinforced with bronze or backed with steel, or bonded with steel, cast iron, or bronze.



New Combination Indicating and Recording Potentiometer Pyrometer

Self-Contact Pyrometer

FOR USE in industries where a pyrometer recorder is subject to particularly severe conditions, the Uehling Instrument Company, 29 Vesper St., Paterson, N. J., has developed what is known as the self-contact potentiometer pyrometer. The instrument is used either with a thermocouple or an electric resistance bulb. Special construction makes possible reliable and definite contact between the needle of the galvanometer and the stationary contact pieces, according to the manufacturer, without the use of any auxiliary mechanical devices such as depressor bars. This arrangement makes it possible to place the galvanometer apart from the recorder at almost any distance. The galvanometer may thus be located where it will not be damaged, while the recorder, which is said to be

very simple and rugged, is installed wherever it may be needed. One galvanometer will actuate as many as four recorders. If desired, each recorder may be measuring a different temperature.

As shown in the accompanying illustration, one special feature of the recorder is the indicating scale. This is a translucent endless belt about 2 ft. long which is illuminated and moves past a stationary indicating pointer. This scale is said to be readable at a distance of 75 ft. or more.

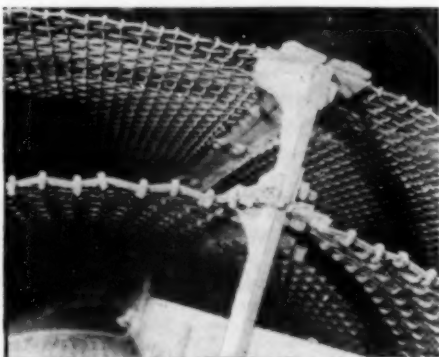
Static-Proof Belting

NATURAL CREEPING of belts on pulleys is responsible for the generation of static electricity on the belt. This effect is generally small in damp weather, but in dry weather, where there are explosion hazards, it is necessary to use some method for removing the static charge. This method may employ a conducting coating on the belt, or it may use a wire gauze hung so as to touch the belt and ground it.

Charles A. Schieren Company, 30 Ferry St., New York, points out that these methods are reliable only if properly maintained. This company has, consequently, developed a static-proof belt in which a row of copper wire stitching along each edge of the belt makes contact with the pulley faces at all times. In this way, static charges are led off through the belt by means of the wire stitching. The manufacturer claims that it is then only necessary to see that the machines are well grounded to avoid any future danger from static charges, as the belt is said to be permanently static-proof.

New Alloy Screens

FOR SEVERE service on revolving, vibrating, shaking, and gravity screens, Ludlow-Saylor Wire Company, St. Louis, Mo., has developed a hard, resilient alloy known as "Spring-Steel."

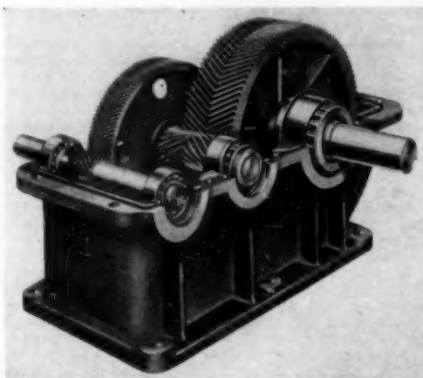


Two Jackets on Revolving Screen Made of "Spring-Steel"

According to the manufacturer the first installation of this material, made four years ago, is still in satisfactory service. Operating on various abrasive materials, the new alloy is reported to last several times as long as ordinary screens. It is now available in all grades required for heavy sizing duty.

New Speed Reducers

SINGLE- and double-reduction reducers of an improved design are being offered by Foote Bros. Gear & Machine Company, 111 North Canal St., Chicago, Ill. These are obtainable with either herringbone or helical gears, while all models are equipped with anti-friction bearings. Ball bearings are used on the high-speed shafts, and



Double-Reduction Herringbone Speed Reducer

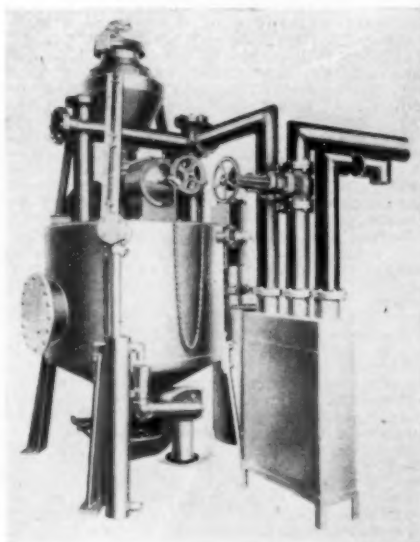
roller bearings on the low-speed shafts.

This new line is known as the "Titan" and is made in ratios from 2.87 to 9.9 in single-reduction units and from 9.95 to 96.2 in the double-reduction. Features include high efficiency, heat-treated and hardened gears in the case of the helical models, and high load-carrying capacity.

Acetylene Generators

TWO IMPROVED TYPES of non-automatic stationary acetylene generators for supplying large volumes of acetylene have been announced by Oxweld Acetylene Company, 30 East 42d St., New York. These are each made in two sizes: 500 and 1,000 lb. carbide capacity. Type NA-3, shown in the illustration, delivers gas to a storage holder weighted to supply the shop piping system at a pressure of 20 in. of water. The carbide is fed by a rotary

Large-Capacity Non-Automatic Acetylene Generator



feed screw, driven by a water motor. This is automatically stopped when the acetylene holder is full. A feature of this equipment is a wash box which acts as a scrubber for the gas and also as a vacuum release when the residue is being drained. Otherwise, the generator is not automatic. Type NA-4 generator is similar to the one described except that it includes a booster, capable of delivering acetylene to the piping system at any pressure not to exceed the permissible limit of 15 lb. per square inch.

Multiple Lift Hand Truck

LOADS up to 6,000 lb. may be lifted in from two to eight strokes by means of two new models of multiple lift truck which have been announced by Barrett-Cravens Company, State and 87th St., Chicago. For light loads, a minimum of two strokes is necessary, or for the complete lift of 2½ in. a minimum of four strokes must be used. With heavy loads, the operator may take up to eight easy strokes. For light loads, he may use two, three, or four quick strokes. The truck is equipped with roller bearings in all wheels and is provided with a hydraulic check for lowering and an automatic spring handle holdup.

Fire Extinguishing Equipment

A NEW FORM of fire extinguisher which utilizes a dry chemical, expelled in a cloud by nitrogen or carbon dioxide, has been developed by the Du-Gas Fire Extinguisher Corporation, 11 West 42d St., New York. The company is prepared to supply a 2½-gal. hand extinguisher and three sizes of extinguishers mounted on wheels, ranging from 10 to 40 gal.

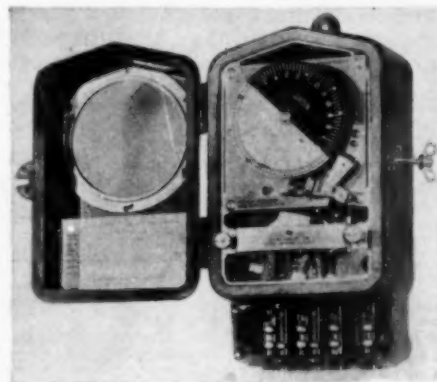
The method briefly consists in blowing a dry, powdered chemical, which gives off carbon dioxide when heated, through a hose and controlled nozzle by means of an inert gas. In the hand extinguisher, the inert gas is carbon dioxide, which is contained under pressure in the extinguisher body. In the larger sizes, a separate cylinder of nitrogen under 2,000 lb. pressure serves to expell the extinguishing chemical in a cloud. The range of this cloud is about 30 ft. and its blanketing effect permits the operator, according to the manufacturer, to approach close to the fire. The extinguisher is said to be suitable for all types of fires and has been approved by the Underwriters' Laboratories for use on Class B fires in flammable liquids.

Among the advantages claimed for the extinguisher are the rapidity of its blanketing and smothering action, its effect of blowing out the flame, the impossibility of its freezing, and the non-injurious character of the chemicals.

Electric Time-Switch

ELECTRIC WINDING of the clock is incorporated in a new time-switch which has been announced by the

Sangamo Electric Company, Springfield, Ill. This consists of an electrically wound Hamilton-Sangamo clock driving a switch dial which rotates once in 24 hours. The clock spring is kept wound by means of an electric motor and will operate the clock for several hours in the event of power failure. The switch dial is marked off in intervals of 15 minutes, at each of which points there are two holes into which pins may be



Electrically Wound Time Switch

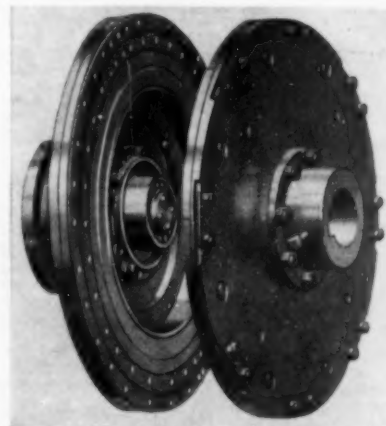
inserted. These pins serve to make or break the circuit, through a mercury switch. This circuit may be completed as often as every 15 minutes or at any other desired intervals throughout the day.

Electrical Equipment

RECENT announcements of new equipment made by Cutler-Hammer, Inc., Milwaukee, Wis., include a new three-position pilot switch and a magnetic clutch. The switch is intended for use with all types of equipment which are controlled by automatic pilot devices such as float switches, pressure switches, and so on. The new three-position switch has an operating lever which can be turned to either the "automatic," "off," or "manual" position. This enables the operator to start or stop the equipment manually or put it under automatic control.

A new line of magnetic clutches, known as Type L, is said to give a

New Magnetic Clutch Showing Field Member at Left and Armature Member at Right



greater and steadier magnetic pull throughout the life of the lining than other types. As shown in the accompanying illustration, the field member, which is constructed for easy disassembling, is mounted on a roller bearing, which extends into the armature hub, thus assuring perfect alignment and concentricity. To assure good contact without arcing, the brass collector rings are provided with two carbon brushes. A lining-wear indicator shows the operator when the lining has worn to a point where it must be readjusted.

Manufacturers' Latest Publications

Agitation. Patterson Foundry & Machine Co., East Liverpool, Ohio—12-page bulletin on agitators and agitator drives.

Apparatus. American Instrument Co., 774 Girard St., N.W., Washington, D. C.—Bulletin 505—Describes the Carson curl sizing tester for determining the degree of sizing of paper; Bulletin 506, describes an opacity meter for testing transparency.

Apparatus. American Photoelectric Corp., Third Ave. & 18th St., New York—5-page reprint of a paper by Monroe Barnard and Paul McMichael on precision color-measuring apparatus for the paper industry.

Apparatus. J. Bishop & Co. Platinum Works, Malvern, Pa.—Folder stressing the importance of uniformity in platinum ware.

Apparatus. Emil Greiner Co., 55 Vandam St., New York—Catalog of hand centrifuges, centrifuge tubes, and equipment for the examination of oils.

Chemicals. Dow Chemical Co., Midland, Mich.—Bulletin discusses the use of orthophenylphenate in the preservation of glue.

Chemicals. Vanadium Corp. of America, 120 Broadway, New York—Catalog and Price List No. 3—Gives prices of vanadium, chromium, molybdenum, titanium, tungsten, and zirconium metals and compounds made by this company.

Chemicals. Victor Chemical Works, 343 So. Dearborn St., Chicago, Ill.—20-page booklet reprinting an article by H. E. Millson on the use of formic acid in textile dyeing.

Compressed Air. Centrifex Corp., 3029 Prospect Ave., Cleveland, Ohio—Bulletin 158—Describes a new centrifugal cleaner for compressed air, adapted to remove water and other impurities after the compressor.

Compressors. Pennsylvania Pump & Compressor Co., Easton, Pa.—Bulletin 153—8 pages concerning two-stage air compressors of the straight-line tandem type; also Bulletin 150, describing aftercoolers of tubular construction for use with air compressors.

Compressors. Yeomans Bros. Co., 1433 Dayton St., Chicago, Ill.—Bulletin AC-7100—8 pages, describing rotary compressors and dry vacuum pumps, for pressure to 50 lb. gage or vacuum to 95 per cent of barometer.

Crystallization. Swenson Evaporator Co., Harvey, Ill.—Article X—Final article in a series on heat transfer and crystallization entitled "Practice of Industrial Crystallization," by Dr. W. L. McCabe.

Detergents. The Quigley Co., 56 W. 45th St., New York—16-page booklet describing Annite, a general industrial detergent.

Disintegration. Jeffrey Manufacturing Co., Columbus, Ohio—Bulletin 510—Describes the new "Flextooth" crusher made by this company.

Drying. Colorado Iron Works Co., Denver, Colo.—Catalog 32-C—32-page booklet completely describing the drying of fine materials and including a description of the Lowden dryer.

Drying. Despatch Oven Co., 623 9th St., S.E., Minneapolis, Minn.—Bulletin 10—4-page folder describing continuous conveyor ovens for drying and baking operations on finishes, cores and molds, moist articles and other special processes.

Electrical Equipment. Allis-Chalmers Mfg. Co., Norwood, Ohio—Leaflet 2124—Describes the ARZ fully-enclosed fan-cooled motor.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as

follows: GEA-38-B, D.C. Crane Hoist Motors; GEA-161-F, Novalux Flood Light Projectors; GEA-211-A, Oil Circuit Breakers; GEA-388-A, Control Equipment for D.C. Crane and Trolley Motors; GEA-394-B, Induction Motor-Generator Sets; GEA-481-C, Live-Line Disconnecting Clamps; GEA-530-B, Control Equipment for D.C. Crane Hoist Motors; GEA-532-C, Electric Heating Equipment; GEA-750-B, Induction Frequency Converters; GEA-858-A, Low Speed D.C. Generators; GEA-885-A, Super-Synchronous Motor; GEA-904-D, Single-Stage Centrifugal Air Compressors; GEA-977-B, Fractional Horsepower Capacitor Motors; GEA-1096-A, Indoor Disconnecting Switches; GEA-1089-A, Automatic Telemetering Equipment; GEA-1152-A, Synchronous Motors for Pumping; GEA-1161, Arc-Welding Structural Steel; GEA-1172-A, Super-Synchronous Motors for Grinding and Pulverizing; GEA-1210, Electric Equipment for Cranes; GEA-1230-A, Industrial Haulage Locomotives; GEA-1265-A, Thermostat for Industrial Heating Units; GEA-1277, Fractional Horsepower Motors; GEA-1280, Centrifugal Compressors; GEA-1283, Cam-Type Master Switches; GEA-1284, Geared-Type Limit Switches; GEA-1285, Track-Type Limit Switches; GEA-1286, Industrial Haulage Locomotives; GEA-1287, Industrial Haulage Locomotives; GEA-1290, Control Equipment for D.C. Motors; GEA-1291, Copper Brazing Furnaces; GEA-1295, Edge-Wound Resistors; GEA-1294, D.C. Motors; GEA-1296, Brakes for D.C. Motors; GEA-1297, Electric Cable Reel Equipment; GEA-1303-A, Squirrel Cage Induction Motors; GEA-1318, Quartz-Rod Thermostat.

Equipment. American Welding Co., 30 Church St., New York—Bulletins 2002 and 3003—Respectively describe Rowland forged-welded containers for compressed gases and liquids, and forge-welded storage tanks and pressure vessels for other purposes, giving details of construction and other data.

Equipment. J. H. Day Co., Cincinnati, Ohio—Catalog 303—78-page catalog describing special process machinery for mixing and kneading, shredding, dissolving, dispersing, sifting, grinding, masticating, disintegrating, pulping, and packing.

Equipment. De Laval Steam Turbine Co., Trenton, N. J.—40-page book describes pumps, turbines, compressors and speed reducers for the oil industry. Charts give flow of oils at various viscosities in pipes from 2 to 12 in. diameter.

Equipment. Robinson Mfg. Co., Muncy, Pa.—Booklet briefly describing the disintegration, mixing, sifting and conveying equipment made by this company.

Glass-Lined Equipment. The Pfaunder Co., Rochester, N. Y.—Catalog 715—28-page catalog on glass-lined equipment including reaction kettles, storage and mixing tanks, condensers, and drive equipment. Also Bulletin 716, describing glass-lined steel evaporating pans to 150-gal. capacity.

Instruments. The Bristol Co., Waterbury, Conn.—Catalog 4000—20-page catalog describes air-operated vacuum, and temperature controllers with details on bulbs, capillary protection and thermometer wells.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Catalog 15-A—New 104-page catalog describing and illustrating equipment for indicating, recording and automatically controlling temperature by means of pyrometers. Also 32-page booklet illustrating general types of control equipment and methods of application, entitled "The Era of Automatic Control."

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 1229—12 pages on the use of graphic instruments in continuous plant surveys.

Instruments. Foxboro Co., Foxboro, Mass.—Bulletin 167—36-page booklet on the application of throttling pilot controls and valves and the design of the Foxboro V-port valve, with engineering data and calculations for ideal flow characteristics and valve size.

Instruments. Harold E. Trent Co., 439 No. 12th St., Philadelphia, Pa.—Bulletin TB-18—Describes indicating temperature control gages and regulators for temperatures to 1,000 deg. F.

Insulation. Cork Insulation Co., 154 Nassau St., New York—September, 1930, price list of cork pipe coverings for refrigerated lines; includes information on use, insulation and maintenance as well as weights and sizes.

Lighting. Benjamin Electric Mfg. Co., Des Plaines, Ill.—"A Guide to Productive Lighting for Industry," 48-page handbook on principles of lighting, together with description of lighting equipment made by this company.

Materials Handling. Lewis-Shepard Co., 125 Walnut St., Watertown Station, Boston, Mass.—15-page catalog describing a complete line of standard and special floor trucks of many varieties.

Materials Handling. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill.—Folder 1248—Describes the "Cub" portable belt conveyor made by this company.

Materials Handling. The Sherman Corp., 285 Madison Ave., New York—A folder describing an investigation of a client's materials handling problems and the solution to these problems.

Materials Handling. Stephens-Adamson Mfg. Co., Aurora, Ill.—4-page folder—Describes a new type of manganese steel feeder for handling large tonnages of abrasive bulk materials.

Metals and Alloys. Climax Molybdenum Co., 295 Madison Ave., New York—Booklet describing the properties of calcium molybdate and its use in producing alloys; 46 pages.

Metals and Alloys. Handy & Harman, 57 William St., New York—Describes briefly advantages of silver and silver alloys, giving physical properties and corrosion data.

Metals and Alloys. Hevi Duty Electric Co., Milwaukee, Wis.—Bulletin 830—8 pages on process and equipment for nitriding.

Metals and Alloys. I.C.I. Metals, Ltd., Smethwick, England—Bulletin discusses the use of "Alumbror," a corrosion-resistant aluminum-brass for condenser tubes.

Metals and Alloys. International Nickel Co., 67 Wall St., New York—Nickel Steel Bulletins Nos. 1-A and 17—Respectively covering S.A.E. standard specifications for steels, and an article by Charles McKnight on the subject of nickel-alloy-steel forgings.

Mixing. Storms-Harvey Equipment Co., 50 W. 3d St., New York—Catalog describing mixers, paint and ink machinery, pumps, fire-fighting equipment and other apparatus for the paint, ink and chemical industries.

Molding. Celluloid Corp., 10 E. 40th St., New York—22-page booklet describing the physical and chemical characteristics of "Lumarith," and giving information on molding equipment and procedure.

Oil Burners. Hauck Mfg. Co., 126 10th St., Brooklyn, N. Y.—Sheet No. 403—Describes a new line of Venturi-type triple-atomizing oil burners for operation with low pressure air.

Power Generation. De Laval Steam Turbine Co., Trenton, N. J.—"A Pioneer in High Pressure Steam," booklet describing the early De Laval turbine and the generation of steam as shown at the Stockholm Exhibition in 1897. Modern turbines are also described.

Power Transmission. Falk Corp., Milwaukee, Wis.—Bulletin 230—68-page catalog with selection, dimension and engineering data on parallel-shaft speed reducers.

Power Transmission. Worthington Pump & Machinery Corp., Harrison, N. J.—Folder briefly describing the new Worthington "Multi-V Drive," a joint product of Worthington and the Goodyear Tire & Rubber Co.

Protection. Norfolk Paint & Varnish Co., Norfolk Downs, Mass.—26-page book describing and specifying paints and varnishes for industrial, technical and architectural purposes. Includes many special finishes for industrial work.

Refrigeration. Roessler & Hasslacher Chemical Co., Niagara Falls, N. Y.—Technical Paper 274—Completely describes the use of "Artic" methyl chloride as a refrigerant; 39 pages.

Safety. Metropolitan Life Insurance Co., Policy-Holders Service Bureau, 1 Madison Ave., New York—Industrial Safety No. 9—16-page discussion of methods used to provide safe working conditions in plants.

Spray Nozzles. Spraco, Inc., 114 Central St., Somerville, Mass.—Bulletin 475—20-page bulletin describing various standard and special sprays for atomizing liquids or liquids and gases, including data on sizes and performance.

Sulphuric Acid. Leonard Construction Co., 37 So. Wabash Ave., Chicago, Ill.—10-page booklet describing the engineering services of this company and sulphuric acid plants using vanadium catalysts built by the company.

Valves and Fittings. Walworth Co., Boston, Mass.—Catalog 58—754-page general catalog of valves and fittings of all types, together with drive-well points and accessories, pipe tools and steam accessories; also many useful tables.

Water Still. Barnstead Still & Sterilizer Co., Forest Hills, Boston, Mass.—Catalog B—General catalog in seven sections describing water-distilling equipment for scientific, industrial, commercial, medical, professional, and domestic purposes. Lists large numbers of users of this equipment.

Welding. Babcock & Wilcox Co., 85 Liberty St., New York—Book describing new method of fusion welding discussed elsewhere in this issue of *Chem. & Met.* It describes application, properties and testing by non-destructive methods of this type of welding.

PATENTS ISSUED

Sept. 2 to Sept. 30, 1930

Rubber, Rayon and Plastics

Process of Making High-Grade Viscose Products. Alwin Jäger, Chemnitz, Germany, assignor to the firm Oscar Kohorn & Company, Chemnitz, Germany.—1,774,712.

Method of Manufacturing Colorless and Transparent Phenol Resin. Michisuke Nakamura, Hiratsuka Mura, Ebara Gun, Tokyo Fu, Japan, assignor to Sankyo Kabushiki Kaisha, Muromachi, Nihombashi Ku, Tokyo, Japan.—1,775,135.

Production of Artificial Masses from Casein. Otto Schmidt and Karl Seydel, Ludwigshafen, and Egon Meyer, Mannheim, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,775,175.

Method of Preparing Cellulose-Ester Solutions. Jacob Kleinhaus Weidig, Newark, N. J., assignor to the Cellulose Utilites Corporation.—1,775,179.

Aqueous Emulsion of Rubber, Balata, or Gutta-Percha and Process of Producing the Same. William Beach Pratt, Wellesley, Mass., assignor, by mesne assignments, to Dispersions Process, Inc., Dover, Del.—1,775,569.

Method of Polymerizing Vinyl Compounds. Charles O. Young and Stuart D. Douglas, Charleston, W. Va., assignors to Carbide and Carbon Chemicals Corporation.—1,775,882.

Manufacture of Phenolic Resins. Norman Strafford and Eric Everard Walker, Blackley, Manchester, England, assignors to British Dyestuffs Corporation, Ltd., Manchester, England.—1,776,202-3.

Rubber Composition. Irvin W. Humphrey, Wharton, N. J., assignor to Hercules Powder Company, Wilmington, Del.—1,776,857.

Process of Preparing Formaldehyde-Primary Aromatic Amine Condensation Products. Willy Hildebrand, Griesheim, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,777,140.

Water-Resisting Adhesive Composition of Matter. Arthur Biddle, Trenton, N. J., assignor to United Products Corporation of America.—1,777,157-62.

Petroleum and Coal Products

Process for the Separation of Constituents of Coke-Oven Gases and the Like. Jegor Israel Bronn, Berlin-Charlottenburg, and Georg Fischer, Oberhausen, Germany.—1,774,633.

Treatment of Petroleum Oils and Products Derived Therefrom. Frederick Garthe-waite Ring, Winchester, Mass., and Percy George Paris, Bethlehem, Pa., assignors to Bethlehem Steel Company.—1,775,052.

Treatment of Hydrocarbons. Ernest B. Phillips, East Chicago, and James G. Stafford, Whiting, Ind., assignors to Sinclair Refining Company, New York, N. Y.—1,774,611.

Process for Treating Petroleum Hydrocarbons. Roy Cross, Kansas City, Mo., assignor to Gasoline Products Company, Inc., Wilmington, Del.—1,775,067.

Coke Oven. Evence Coppée, Brussels, Belgium.—1,775,191-2.

Coke Oven Gas Connection. Otto E. Klockman, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,775,494.

Apparatus for the Carbonization of Fuel. Erich Rammelkamp, Duisburg, Germany, assignor to Chemisch-Technische Gesellschaft m. b. H., Duisburg, Germany.—1,775,570.

Purification of Liquid Hydrocarbons. Ferdinand Bernard Thole and Stephen

Thomas Card, Sunbury-on-Thames, England, assignors to Anglo-Persian Oil Company, Ltd., London, England.—1,776,340.

Distillate Petroleum Liquid. James B. Rather and Leslie C. Beard, Jr., Brooklyn, N. Y., assignors to Standard Oil Company of New York, New York, N. Y.—1,776,598.

Process of Decomposing Relatively High-Boiling Point Oils Into Relatively Low-Boiling Point Oils. Archie L. Strout, Berkeley, Calif., assignor to Standard Oil Company of California, San Francisco.—1,776,985.

Organic Processes

Process of Concentrating Aqueous Chloroacetaldehyde Solutions. Otto Ernst and Heinrich Lange, Frankfurt, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,774,507.

Process for the Manufacture of Adsorbent Carbons. Oscar L. Barnebey, Columbus, Ohio.—1,774,585.

Process of Extracting Oil from Cottonseed. Robert O. Boykin, Los Angeles, Calif., assignor to N. Russell Vail, Los Angeles, Calif.—1,775,154.

Method of Making Arylamines. William H. Williams, Midland, Mich., assignor to Dow Chemical Company, Midland, Mich.—1,775,360.

Copies of Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Photostatic copies of foreign patents may be obtained at the same address, prices being forwarded on application.

Process for the Extraction of Fat from Raw Wool. Alfred Engelhardt, Wiesdorf, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,775,590.

Composition of Matter. Herbert H. Dow and John J. Grebe, Midland, Mich., assignors to Dow Chemical Company, Midland, Mich., *Diphenyl oxide and carbon tetrachloride*.—1,775,716.

Iron Carbonyl Compositions and Their Manufacture. Alwin Mittasch and Martin Müller-Cunradi, Ludwigshafen, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,776,920.

Inorganic Processes

Method of Refining Pigments. Harold Grossman, Caldwell, N. J., assignor of one-fourth to William S. Pritchard, New York, N. Y.—1,774,510.

Barium Carbonate and Sodium Sulphate Manufacture. James B. Pierce, Jr., Charleston, W. Va., assignor to Barium Reduction Corporation, Charleston, W. Va.—1,774,523.

Utilization of Greensand. William Vaughan, Mount Holly, N. J., and William M. Bruce, New York, N. Y., assignors to Permutit Company, New York, N. Y.—1,774,533.

Aluminum Beryllium Alloy. Robert S. Archer and William L. Fink, Cleveland, Ohio, assignors to Aluminum Company of America, Pittsburgh, Pa.—1,774,542.

Process of Recovering Iodine. Charles W. Girvin, Long Beach, Calif., assignor, by mesne assignments, to General Salt Company, Long Beach, Calif.—1,774,882.

Production of Iron-Oxide Pigments. Julius Laux, Uerdingen, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,774,932.

Method of and Apparatus for Air Liquefaction. Isaac H. Levin, Pittsburgh, Pa., assignor, by mesne assignments, to Gas Industries Company, Pittsburgh, Pa.—1,775,434.

Manufacture of Metal Oxides. Robert Griessbach and Julius Eisele, Ludwigshafen, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,775,640.

Separation of Oxy-salts from Alkali Mixtures Containing Same. Henry Harris, London, England.—1,775,676.

Process of Making Phosphoric Acid and Cyanamide. Thaddeus F. Baily, Alliance, Ohio.—1,775,802.

Process of Making Barium Sulphide Solutions. Henry Howard, Cleveland, Ohio, assignor, by mesne assignments, to Grasselli Chemical Company, Cleveland, Ohio.—1,776,029.

Fixation of Atmospheric Nitrogen. James Brightmore, Tideswell, England.—1,776,303.

Manufacture of Double Salts of Calcium Nitrate. Emil Lüscher, Basel, Switzerland, assignor to Lonza Elektrizitätswerke und Chemische Fabriken Aktiengesellschaft, Basel, Switzerland.—1,776,694.

Manufacture of Phosphoric Acid. Sven Gunnar Nordengren, Landskrona, Sweden, assignor to Aktiebolaget Kemisha Patenter, Landskrona, Sweden.—1,776,595.

Process for the Purification of Phosphatides. Hermann Bollmann, Hamburg, Germany.—1,776,720.

Process for the Oxidation of Natural Gas. Edmond Herbert Boomer, Edmonton, Alberta, Canada, assignor to the Governors of the University of Alberta, Edmonton, Canada.

Catalyst of High Mechanical Strength. Rudolf Wietzel, Ludwigshafen and Ernst Willfroth, Neurossen, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,776,875.

Method of Manufacturing Chemically-Pure Sulphuric Acid. Walter S. Allen, Flushing, N. Y., assignor to General Chemical Company, New York, N. Y.—1,777,025.

Method of Recovering Soluble Beryllium Compounds. Hirsch Loewenstein, Karlsruhe in Baden, Germany.—1,777,267.

Miscellaneous Processes and Equipment

Jordan Engine. Edward A. Jones, Pittsfield, Mass., assignor to E. D. Jones & Sons Co., Pittsfield, Mass.—1,774,556.

Apparatus for Making Plate Glass. Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Company.—1,775,125.

Fractionating Tower. John C. Black, Destrehan, La.—1,776,061.

Process of Disposing of Sulphuric Acid Materials. Charles Hinde, Wilmington, Calif.—1,776,070.

Electrolytic Method of Cleaning Metal. Thomas E. Dunn, Bridgeport, Conn., assignor, by mesne assignments, to Bullard Company, Bridgeport, Conn.—1,775,671.

Filtration Process and Apparatus. Charles T. Cabrera, New York, N. Y., assignor to Electro Dialyzer Corporation, New York, N. Y.—1,776,883.

Storage Device for Volatile Liquids. Henry Howard, Cleveland, Ohio, assignor, by mesne assignments, to Grasselli Chemical Company, Cleveland, Ohio.—1,776,907-8.

Process and Apparatus for the Liquefaction of Gases. Christian Wilhelm Paul Heylandt, Lankwitz, Germany, assignor to Fluga Aktien-Gesellschaft, St. Moritz, Switzerland.—1,777,040.

NEWS of the INDUSTRY



Safety Men Attack Problems Of Chemical Plants

WHILE 7,000 safety delegates from all industries and all sections of the country were meeting in Pittsburgh, Sept. 29 to Oct. 3 for the 19th Annual Congress of the National Safety Council, about 200 members of the Chemical Section were giving detailed study to accident prevention and safe practices in the field of chemical engineering. Four sessions were held under the chairmanship of C. F. Whittemore, of the Western Electric Company.

Some enviable safety records for chemical plants were cited by John Roach, Deputy Commissioner of Labor for New Jersey, in a statistical summary on 84 chemical plants, representing 120,000,000 man-hours of employment. The Celluloid Corporation, for example, reduced its man-hour losses from 9,000 in 1928 to 3,000 in 1929, while for eight months in 1930 only 350 man-hours have been lost. In 1925 there were 181 lost-time accidents reported among 1,053 men in the Hercules Powder Company, while in 1929 for 2,807 men the total had fallen to 34.

A paper by A. L. Barth, of the Du Pont company, on the care and use of protective equipment in chemical industry aroused lively discussion, particularly of the types of gas masks best suited for chemical requirements. Mr. Barth contended that the mask must be regarded as a necessary but purely emergency protective device and therefore should not enter into regular operating procedure.

Two of the sessions were held in the Pittsburgh Experimental Station of the U. S. Bureau of Mines, where the safety men inspected much of the important work being done on the toxicity of certain chemicals and their fire and explosion hazards. J. J. Forbes described the co-operative first-aid training courses of the Bureau, particularly in relation to the organizing of plant groups under key men who had received instructions from the Bureau. This practice is increasing greatly. E. St. John Perrott and W. T. Yant reviewed and discussed the safety investigations and the Bureau's approval system in its application to chemical industry.

Two important hazards, benzol and dust, were reviewed by competent authorities. P. W. Gumaer, of the Barrett Company, described in detail the procedure for the ventilation of heavier-than-air vapors. J. J. Bloomfield of

the U. S. Public Health Service, discussed the relation of dust in industry to death and disease among workers. At a subsequent session, Dr. Carey P. McCord, of Cincinnati, reported on an investigation of the toxicity of benzol and its impurities. M. E. Bonyun, of the maintenance department of the Du Pont dye works, Deepwater, N. J., had a paper on the safe handling of unfired pressure vessels and equipment which reported in detail on the boiler-code requirements.

Officers of the Chemical Section of the National Safety Council elected for next year are as follows: general chairman, John S. Shaw, Hercules Powder Co., Wilmington, Del.; vice-chairman, John Roach, Deputy Commissioner of Labor, Department of Labor, Newark, N. J. (in charge of program committee); vice-chairman, in charge of engineering, A. L. Armstrong, of the Eastman Kodak Company, Rochester, N. Y.; secretary, H. C. Mougey, General Motors Research Laboratories, Detroit, Mich.; chairman in charge of posters, slides and safety kinks, George H. Miller, of the Du Pont Company; chairman in charge of membership committee, Joe M. McVey, Hercules Powder Company, Wilmington, Del.; chairman publicity committee, Sidney D. Kirkpatrick, *Chem. & Met.*; chairman statistics committee: Ira V. Kepner, Pennsylvania Salt Manufacturing Company; members of the executive committee at large: Lewis A. DeBlois, consulting engineer, New York City; C. F. Whittemore, Western Electric Company, Chicago, Ill.; F. E. Clancy, Mathieson Alkali Works; H. L. Miner, Du Pont Co., Wilmington, Del.; S. E. Whiting, Liberty Mutual Insurance Company, Boston, Mass.; Fred W. Roseland, manager Newark Safety Council, Newark, N. J.; E. J. Smith, Underwriters Laboratories, Chicago, Ill.

New Salt Cake Plant

The Rhodes Alkali & Chemical Corporation has started operation of its new sodium sulphate plant on Rhodes Marsh, nine miles south of Mina, Nev. According to present plans, the output is expected to be 10,000 tons a year.

The solution is pumped from the marsh into crystallizing ponds, where the crystallization takes place through action of solar heat. The solar heat system is sufficient because of the simplicity of the brines, which are mainly sodium chloride and sodium sulphate.

Chemical Exposition Plans Assume Shape

PLANS for the Thirteenth Exposition of Chemical Industries, which will be held at the Grand Central Palace, New York, during the week of May 4, 1931, are in progress and rapidly taking shape.

The students course of lectures will again be under the chairmanship of Prof. W. T. Read, now dean of chemistry at Rutgers University, and concerning the course, he states that experience of the 1929 course has indicated that a change of policy is necessary. The previous fall days found most colleges and universities either on the eve of opening or having been open such a short time that the few days lost from the campus were not a serious matter, but with the exposition coming early in May, near the close of the academic year when reviews are under way and final examinations are in sight, it is difficult for any institution to excuse students of chemistry and chemical engineering for a full week.

New plans call for three successive courses of two days each. One course will cover the elements of chemical engineering equipment, and the more important types of apparatus with which chemical engineering operations are carried out. Following this will be a two days' advanced course dealing with the more specialized equipment of recent development in various fields, reviews of research which have marked advances from the theory and principles of chemical engineering. The third course will deal with the new materials and processes of chemical industry, due emphasis being made on the chemical theories and principles.

The advisory committee of the exposition includes Dr. Arthur D. Little (chairman), Raymond F. Bacon, L. H. Baekeland, J. V. N. Dorr, Lamot duPont, Henry B. Faber, Moses Gomborg, Williams Haynes, Charles H. Herty, H. E. Howe, Louis Kahlenberg, Sidney D. Kirkpatrick, Fred W. Payne, W. T. Read, Charles F. Roth, L. V. Redman, H. J. Schnell, R. Gordon Walker, A. H. White, David Wesson, M. C. Whitaker, T. B. Wagner, and Victor Williams.

The exposition is being managed by the International Exposition Company at the Grand Central Palace, New York, with Charles F. Roth and F. W. Payne as managers.

Chemical Engineers Will Meet in New Orleans

AFTER ten years, New Orleans is to be the scene on Dec. 8, 9, and 10 of another annual meeting of the American Institute of Chemical Engineers. In that period a number of remarkable technical developments have had their origin in this vicinity. For example, the hydrogenation of petroleum was adapted from the German coal-liquefaction process by a group of American chemical engineers working in the Baton Rouge refinery of the Standard Oil Company of Louisiana. Paper manufactured from the slash pine of the South received much of its impetus from work done at Bogalusa, La. The steam explosion process of making insulated lumber was developed commercially at Laurel, Miss. The near-by gas fields at Monroe and Sterlington, the largest in the United States, now hold a great deal of interest, not only because of the new long-distance pipe lines to St. Louis, Birmingham, and Atlanta but also because of the growing use of natural gas as a chemical raw material. Long the center of the cane sugar industry in this country, it is natural that Louisiana should have witnessed many of the recent advances in this technology.

These and other subjects of interest to the chemical engineer are to be featured in the technical program being arranged by a committee headed by Robert T. Haslam, vice-president and general manager of the Standard Oil Development Company. The general chairman of the meeting is Prof. Charles S. Williamson, Jr., of Tulane University, whose local committee has been at work for several months arranging plant visits and preparing for the social features and entertainment of the chemical engineers. Frederic J. Le Maistre, executive secretary of the American Institute of Chemical Engineers, Bellevue Court Building, Philadelphia, will shortly have available the full details of the program.

Gas Men in Meeting At Atlantic City

STABILITY with flexibility is the first necessity of the gas industry of America during the present period of radical change, according to Bernard J. Mullaney, president of the American Gas Association, in his address at the opening of the annual convention and exhibit at Atlantic City. Over 5,000 registered members and guests are participating in these sessions from Oct. 13 to 17 and viewing the largest and most complete exhibit of appliances and machinery ever shown in the United States for gas making, distribution, and utilization.

The spectacular growth of natural gas, as "the most important industrial change of the past three years in America," had its influence on every part of the association program. The influence on production, distribution, and utilization

practice has been profound, often revolutionary, as shown both by prepared reports on papers and by the type of machinery exhibited. Gas-manufacturing facilities and household appliances have, in fact, had to yield the spotlight to transmission equipment and to heating appliances both for industrial plant and household.

Reports of the treasurer and of the managing director show enlarged membership in all important classes and an improved financial condition with greater reserves despite greater current spendings.

Officers of the association for the coming year are to be C. E. Paige, Brooklyn, N. Y., president; R. W. Gallagher, of Cleveland, Ohio; N. C. McGowen, of Shreveport, La., and Arthur Hewitt, of Toronto, Ont., vice-presidents; and W. J. Welsh, re-elected treasurer. The chairman of the technical section is to be R. G. Griswold, of Henry L. Doherty & Company, New York City.

Westinghouse Memorial Unveiled at Pittsburgh

A MEMORIAL to George Westinghouse, inventor and industrial leader, was unveiled at Schenley Park, Pittsburgh, on Oct. 6. The monument stands upon a base of Norwegian granite. Its principal component consists of a large central panel flanked by two semicircular wings, all of which are made of gold-leafed bronze with Norwegian granite insets.

The central panel carries the medalion of George Westinghouse supported on an open-work background of oak tree foliage, and on either side are two figures, one a skilled mechanic and the other an engineer with his slide rule. Both the portrait and the figures are modeled in full relief. At the bottom of the central panel is a memorial of the most important period of Mr. Westinghouse's career—a representation of the

Triple Superphosphate Plant for Nashville

ANNOUNCEMENT has been made by the Victor Chemical Works, Chicago, of the erection of a plant at its Nashville works for the manufacture of triple superphosphate for the fertilizer trade. The concentrated phosphoric acid used in the production of this fertilizer material will be produced by the pyrolytic process developed by the Victor Chemical Works in an experimental fuel-fired furnace at Chicago Heights, Ill., during the period 1923-1928. In February, 1929, a large commercial furnace was placed in operation at the company's Nashville works, close to the Tennessee phosphate fields, and in June, 1930, a furnace of still greater capacity was blown in.

The Victor Chemical Works also uses the pyrolytic process for the manufacture of yellow phosphorus and phosphoric acid and phosphates.

first train to be equipped with the Westinghouse airbrake.

Each of the flanking wings is divided into three panels, and on each panel is depicted in low relief one of Mr. Westinghouse's achievements. These include: The illumination of the Chicago World's Fair of 1893 by the alternating-current system developed by Mr. Westinghouse; the hydro-electric plant at Niagara Falls with the 5,000-hp. alternating-current electric generators which were supplied by Mr. Westinghouse and were at that time the largest in the world; the steam turbine, introduced into America by Mr. Westinghouse and now used universally for electric generation by steam power; alternating-current railroad electrification, which Mr. Westinghouse advocated and made practicable; and the airbrake, the most famous of all Westinghouse inventions; and railroad switching and signaling systems, another of the inventor's contributions to the railroad industry.

Westinghouse Memorial in Schenley Park, Pittsburgh



NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

APPPLICATION has been filed with the Tariff Commission by the Lonza Usines Electriques et Chimiques, Switzerland, for a decrease in the duty of 5 cents per pound on alumin, ferrosilicon aluminum, and ferroaluminum silicon, imposed by the 1930 tariff. These products were not mentioned by name in the 1922 tariff, but carried a duty of 25 per cent ad valorem as alloys used in the manufacture of steel. The duty on alumin was increased by a Treasury decision to 5 cents per pound, as an alloy of chief value of aluminum. The importers fought this increase, but the administrative decision was upheld by the U. S. Court of Customs and Patent Appeals, and further recourse was blocked by the refusal of the U. S. Supreme Court to review the case. In the 1930 tariff a uniform specific duty of 5 cents was applied to all three alloys, the Senate accepting the House rate, after proposing that the duty should be 2 cents per pound when in chief value of aluminum; otherwise 25 per cent. Testimony at the hearings indicated that production is variable and has been as high as 6,000 tons. Imports have reached 3,000 tons in a single year. Prices range from 10 to 25 cents per pound, according to grade, in the United States, and from 9 to 13 cents in Europe, according to the Tariff Commission's summary of tariff information.

A decrease in the duty on parachlorometacresol is sought in an application filed by Lehn & Fink, Inc., Bloomfield, N. J. In the 1930 tariff the duty remains the same as in the 1922 Tariff Act at 40 per cent ad valorem and 7 cents per pound.

An increase in the duty of \$4 per ton on crude barytes ore has been applied for by the Clinchfield Sand & Feldspar Corporation, Baltimore, Md. The rate of duty on this material remained the same in the 1930 tariff as in the 1922 tariff.

IN ACCORDANCE with the instruction contained in the new act the Tariff Commission has instituted an investigation to ascertain the approximate average cost per barrel of domestic and Venezuelan (Lake Maracaibo) crude petroleum delivered to the refineries on the Atlantic seaboard during the past three years. Independent producers were defeated in their attempt to obtain a duty on petroleum when the new tariff was in the making.

None of these applications has been assigned for hearing to date. The reorganized Tariff Commission confronts a heavy schedule under new rules of procedure that are designed to expedite administration of the flex-

ible tariff. The burden of proof is thrust upon the petitioner for a change in duty. Opponents likewise must be prepared to make their own defense, as the Commission acts as the final checking, reviewing, and deciding authority. The new rules are regarded as a windfall for lawyers practicing before the Commission, as the success with which applications are prosecuted or opposed will depend to a large extent upon the thoroughness with which the case is presented.

DEVELOPMENTS incident to framing the new industrial alcohol regulations during the past month have not been reassuring to the alcohol-using industries. Despite his earnest efforts, James M. Doran, commissioner of industrial alcohol, has not been able

Chemical Inventories Running Low

Reports received in Washington indicate that the inventories of chemical consumers are generally low and that some manufacturers are not prepared to meet a revival in demand. As the chemical industry is the largest consumer of its own products, it is feared that this condition will tend to hamper the industry when anything like a normal demand appears. In the scramble for supplies, some will be compelled to wait for deliveries, thus tending to put a brake on operations at a time when greater momentum is imminent. For this reason, chemical manufacturers have been advised by their trade association executives to analyze their own inventories thoroughly and instruct their salesmen to survey the inventories of consumers without delay.

to remove the influence impressed upon the permissive system by the suspicious attitude of the Department of Justice.

No sooner had Dr. Doran called in his industrial advisory council on Oct. 3 to establish closer co-operation between the government and the industrial users of alcohol than Amos W. W. Woodcock, director of prohibition in the Department of Justice, aroused resentment throughout the industry by issuing a report estimating illegal diversion of industrial alcohol at 9,929,218 proof gallons in the fiscal year ended June 30, 1929. In this estimate each industry

is charged with an allotted share; lacquer thinners for 2,000,000 gal.; ethyl acetate for 4,000,000 gal.; perfumes and toilet waters for about 4,000,000 gal.

The industry stands suspect on an estimate characterized by Commissioner Doran as "ridiculous and absurd, excessive and unwarranted." Perhaps it was the last 18 gal. in the precise arithmetical total reported by Mr. Woodcock that excited the indignation of Dr. Doran. He declared that Mr. Woodcock's figure, which would represent slightly less than 5 per cent of the denatured alcohol withdrawn during the fiscal year, is not supported by the records of the Bureau of Industrial Alcohol. Commissioner Doran states that the maximum diverted for illegal beverage use was 3,000,000 gal. of ethyl acetate and lacquer thinners and 500,000 gal. of perfume and toilet waters. He explained that these totals represent not industrial alcohol but finished products freely sold in commerce beyond government control. Inquiry developed that neither Howard Jones, assistant director of prohibition in the Department of Justice, nor A. G. Youngquist knew anything about his colleague's "scholarly and unbiased effort to find the truth."

Possible production—with emphasis on the possible—of illegal spirits, wine, and beer from all sources is estimated at 876,320,718 gal., compared with a normal full production of legal alcoholic beverages of 2,256,272,765 gal. in 1914. To the total of 73,386,718 proof gallons of illegal spirits, it is estimated that corn sugar contributed 45,900,000; cane or beet sugar, 10,000,000; grain, 4,000,000; and smuggling, 3,557,500.

In estimating the quantity of spirits produced from corn sugar, Mr. Woodcock's investigators found that of a net production of 887,747,000 lb. of corn sugar, 353,000,000 lb. was used for legitimate purposes in the fiscal year, leaving unaccounted for 534,000,000 lb. of a commodity most generally used by illicit distillers. The report states that an investigation now is being made to determine the actual quantities of low-grade corn sugar consumed in various industries.

An order temporarily continuing in effect the provisional regulations governing industrial alcohol was anticipated on Oct. 9, the date of this dispatch. In the revision that is now under way, the objections of the trade are not directed against matters of major policy, as that remains essentially the same, but against cumbering their operations with a vast amount of picayunish detail that was introduced into the tentative draft of the new regulations.

Satisfactory progress has been made in this revision, according to Commissioner Doran, but it is a tedious process and the prediction that new regulations would not become effective until Jan. 1 is even more certain now than a month ago, especially in view of the request made by the alcohol-using industries that the effective date of the regulations be postponed for one month after they are finally promulgated.

French Chemical Industry Has Satisfactory Turnover

Lack of Research Work Holds Back Greater Progress

From Our Paris Correspondent

THE ECONOMIC situation in France is unchanged. Business is slack, but the chemical industry has no special reason to complain, for the turnover for the first half of 1930 has been practically the same as the one for the corresponding period of the previous year. It will be remembered that 1929 was a good year for chemical industries. However, the introduction of the "assurances sociales," a compulsory insurance by the state, has led to important strikes in the textile centers in the North; then, the customs duties have been raised in the United States, and there are other economic factors which render the future somewhat uncertain. On the other hand, the French chemical industry is developing constantly the scale of its manufactured products, and hopes in that way to make up, thanks to new products, for a diminution in the sales of others.

Generally speaking, one can say that if the French chemical industry has established new manufactures, the latter are not original manufactures which it has elaborated, but often processes which it has acquired by purchase, license, or some other arrangement. In this respect, the French industrial mentality has not changed; it has remained practically the same as before the war, when this industry had, so to speak, not a single research laboratory, but only control laboratories. This state of affairs can be demonstrated by the number of patents which are applied for at the French Patent Office and which gives the following figures: while the I. G. Farbenindustrie A.G., has applied for about 700 patents, the French industrial companies show insignificant figures in comparison: Rhone-Poulenc has 30; Etablissements Kuhlmann, 15; Saint-Gobain, 20; Air Liquide, 10; to quote only the most important firms. It stands to reason that the number of patents is not an absolutely conclusive factor; the technical value of these applications also must be examined.

IN ANOTHER sphere, one notices a dropping off of research work—in the sphere of science and of pure chemistry in particular, where the number of publications of French origin tends to diminish in a way likely to cause some anxiety. One of the most eminent French physico-chemists, M. Jean Perrin, Nobelprizeman, has taken this state of affairs to heart, and has elaborated a scheme for the creation of a body of officials who would devote themselves to scientific research and would be appointed by the state. The latter would bear the expenses caused by this body,

expenses estimated at 25,000,000 francs for the scientific staff, to which another 25,000,000 francs would have to be added for the material and the additional workers. This scheme has met with serious opposition. One has had so many bad experiences in this country with government offices and state administration, that one has to ask seriously if one can continue in a way which has proved particularly costly, and only too often inadequate in its results. However, it is certain that a serious effort is necessary. The twenty million odd francs at present spent yearly on scientific research in France in her university institutions is quite inadequate; but it seems difficult to find the necessary money to help research work outside the state. It must not be forgotten that the Frenchman is not generous, and that his idea of wealth is very different from that of the American.

ON AUG. 1 the nitrogen convention was signed in Paris by the representatives of Germany, Great Britain, France, Belgium, Holland, Italy, Poland, and Czechoslovakia, but only for one year, the agreement terminating on June 30, 1931. As far as France is concerned, this country has maintained the point of view which she had explained in Ostende at a first meeting on June 18 and 19, and it appears that no reduction in production will be asked from French manufacturers as long as the national output does not cover the needs of the country.

As far as nitrates are concerned, French production is still very much below the home consumption, but it is on the upward grade, having passed from 190,000 tons in 1925-26 to 395,000 tons in 1928-29. In regard to ammonia, the imports of ammonium sulphate reached 70,000 tons for the first five months of 1930, having a value of 85,000,000 francs, and this shows that the production is insufficient. It is true that one counts upon the development of works for synthetic ammonia for 1931, and this would allow for covering the needs of the French market. Besides, the manufacture of synthetic nitric acid by the oxidation of ammonia is developing considerably, but not as much as the preparation of synthetic ammonia.

The manufacture of sodium silicate which is usually accomplished by the fusion of sodium carbonate with fine white sand at high temperature, has become more and more important, as this substance is finding increased use for silicating roads made with chalky materials, but with sufficiently hard chalks and having well-defined char-

acteristics; this limits this process to certain districts, notably that of the Doubs. Instead of sodium carbonate the sulphate can also be used for making silicates and, some time ago, it was even proposed to use ordinary salt, but it seems doubtful if this process has been adopted industrially.

The three manufacturers in France are: Saint-Gobain, the Etablissements Kuhlmann, and Bozel-Maletra, which manufactures about 45,000 tons of silicate (estimated as product at 35 deg. Bé.), of which about 10,000 tons comes from Bozel-Maletra, and the remainder from the other two firms. This output is greater than the needs of the French market, and about 5,000 tons is exported.

WE HAVE already pointed out in a previous correspondence the development of the benzol industry, which has grown from 23,000 tons in 1923 to 79,000 tons in 1929, of which 63,900 tons come from the coke ovens and the distillation of coal tar, and 15,300 tons from the various gas works since the removal of benzol was introduced by law in the larger works. Despite this, France still imports 20,000 tons, of which 14,000 tons comes from the Saar. This means a consumption of 100,000 tons in all. This is made up as follows: two-thirds of the total is consumed as fuel; 15,000 tons is used in the dye and pharmaceutical industries, and the remainder for various purposes, notably as solvents. The figures given include also toluol, 2,500 tons; naphtha-solvent, 6,300 tons; xylenes and other hydrocarbons of lesser importance. Despite the progress achieved, France ranks only fourth as a benzol producer, and her production is small compared with the 1,400,000 tons of world production.

Yale Chemists Form Association

YALE chemists and chemical engineers met at "Bethwood," the country home of Prof. Treat B. Johnson, near New Haven, Conn., on Saturday, Sept. 27, and formed the Yale Chemical Association. Some sixty were present at the picnic and luncheon. The guest of honor on this occasion was Prof. W. G. Mixter, now 84 years old, who for many years was a member of the faculty of the Sheffield Scientific School. Brief talks were made by several of those present, dealing both with some of the great teachers of former days and with plans for the future. The first officers of the association are: president, C. O. Johns, Standard Oil Development Company, New York City; vice-president, E. B. Hulburt, J. B. Williams Company, Glastonbury, Conn.; secretary and treasurer, J. J. Donleavy, Yale University, New Haven, Conn.

The officers expect to announce in the near future plans for enlisting the support and co-operation of all former Yale students interested in chemistry, the time of the annual reunion, and the publication of a directory.

German Chemists Report Progress in Various Lines

Fuel Technology, Corrosion, and Alloys Attract Research Workers

From Our Berlin Correspondent

ALTHOUGH recent months brought no major developments in the chemical industry, numerous lesser points deserve mention and attention in their special lines of interest. Thus, in the field of fuel technology, Stilker and Born have reported results on coal briquetting in relation to physical and chemical factors; the dry preparation of coal is beginning to be introduced; and investigations are being made on coal-tar oil for Diesel motors. Meanwhile, the first petroleum deposits in Austria were discovered at the end of July, when the Gewerkschaft Raki-Danubia made a strike at a depth of 728 meters at Zistersdorf, natural gas streaming out in considerable quantities.

The corrosion of metal sheets by automotive fuel was studied by Wawrziniak, Dresden, in quiet and turbulent condition. During driving, the tanks and pipes are subject to a splashing action which is simulated in the tests. At rest, the liquid soon forms a protective coating. Some metals also act as catalyzers, completely changing the character of the liquids. Benzol and gasoline are subject to such changes, while alcohol mixtures even change or split out. In general it was found that zinc and lead were affected most, while tin and aluminum were very resistant.

At the Lautawerk, the action of resting and moving nitric acid on aluminum, silumim, and ferro-silicon was studied. It was found that the aluminum sheet of greatest purity was uniformly attacked, whereas silumim was more strongly attacked. In all cases, annealed metals showed a slighter loss than the hard-rolled. Also, the resting acid promoted attack more strongly than the moving. Attempts to inhibit the corrosion of the pure aluminum had no effect, because the oxide coating used was soon dissolved. In the case of ferro-silicon, riveted onto aluminum, the former showed no loss after 40 days and the combination did not act electrolytically.

ANUMBER of noteworthy new plants in German Upper Silesia within the last two years can now be reported as making satisfactory progress. The Prussian Bergwerke & Hütten A.G., Delbrück, with a yearly production of 900,000 lb. of coke, is now the largest in this region. After building a group of 56 ovens in 1928, it has added 54 coking chambers and enlarged the by-products plant accordingly. At Gleiwitz, the Kokswerke und Chemischen Fabriken A.G. also has a large production and has carried out an amplification program. At Bobreck the Vereinigten Oberschlesischen Hütten-

werke have erected an ammonia plant with the intention of modernizing its coking plant through the construction of two modern groups of 100 to 120 chambers. At Bobreck, too, the Gräflich Schaffgotschen Werke have put the first carbide plant in this region in operation. The intention is to convert their coal, at times salable with difficulty, into electric energy and thus to produce carbide. Their own limestone works supply the raw material; although at present an oven for 40 tons daily is in operation, a much larger oven for 10,000 cu.m. content is in project. At Deschowitz, the company is building a coke plant which will produce only 1,500 tons daily in 60 ovens at first, but will be planned for a double output.

Atomic hydrogen welding, according to the system of Langmuir, is being industrially developed by the A. E. G. in its Arcatom welding process. Molecular hydrogen between two tungsten electrodes is split into atoms by the arc; they absorb heat around the arc, yielding it up again in their reunion at the welded surface. A new chemical solidification process developed by Philipp Holzmann A.G., provides that in setting structural piles a silicate solution and later a solution of a chlorine salt are injected into the ground. The reaction generates gelatinous silicic acid which makes the ground waterproof and supporting.

THE newly discovered metal rhenium, according to Tropsch, catalyzes the hydration of ethylene and promotes the catalytic reduction of carbon monoxide into methanol, similarly to osmium. The carrier employed is porous quartz sand, soaked with potassium perhenate, which is now obtainable (and structurally similar to potassium permanganate).

A step toward the attainment of artificial wool is the recently developed Vistra fiber. It is made from wood cellulose, converted into viscose, and then pressed through spinnerets of such fineness that 70,000 meters of the fiber weighs only 1 kg. The wool-silk of another German rayon factory is made from raw rayon, untwisted fibers of which are cut into the proper staple length, curled, and then fabricated. The artificial wool produced in this way costs about 3.9 to 3 M. per kilogram where washed wool costs 5 to 9 M. per kilogram.

A new apparatus for foamless vacuum distillation, especially applicable for pharmaceuticals and fine chemicals, is designed on the principle that slight pulsating changes in the vacuum influence the surface tension so that the foam is practically destroyed. When

accurately adjusted, the foam formation of liquids is wholly under the control of the worker, and it was found, furthermore, that the speed of distillation can be greatly increased by the choice of the correct pump.

A new nickel-copper-chromium cast iron of great resistance, and easily weldable, has appeared under the name of Nimol. Cheaper than bronze or brass, it has great resistance to corrosion of sulphuric acid, hydrochloric acid, and acetic acid, according to new researches by the Nickel Information Bureau, Frankfurt.

The Société Générale Brégeat, Paris, reports that it has patents on the cleaning of gas pipe lines by the use of Tetralin, which resemble those of Dr. Weissenberger, Berlin, reported in a previous letter. This information is offered without an attempt to compare the relative features.



Industrial Alcohol Council Organized

THE Industrial Advisory Council appointed by Commissioner James M. Doran, of the Bureau of Industrial Alcohol, to co-operate with the bureau in working out problems arising under the National Prohibition Act, met in Washington last month for the purpose of perfecting its organization.

Henry S. Chatfield, of New York City, president, National Oil, Paint and Varnish Association, was elected chairman. A. Homer Smith, of Philadelphia, president of Sharpe & Dohme, and prominent in drug manufacturing circles, was elected vice-chairman. Dr. Harrison E. Howe, of Washington, D. C., chemist and prominent in American Chemical Society affairs, was elected executive secretary.

Commissioner Doran named sixteen industrial and professional leaders as members of the advisory council to promote better understanding and to establish closer co-operative contact between the government and the business public, principally scientific, professional, and trade organizations concerned with the manufacture, distribution, and use of alcohol and liquors for industrial and medicinal purposes.



Oil Refiners to Meet in Chicago

PRELIMINARY program has been issued for the eleventh annual meeting of the American Petroleum Institute at Stevens Hotel, Chicago, Nov. 10-13.

The program calls for a meeting of the Division of Refining on Nov. 12 and on the succeeding day. At the group sessions refinery engineering, motor fuel, and petroleum refining will be the topics discussed and prominent members of the industry are scheduled as speakers.

The business session of the division will be held on the afternoon of Nov. 13 with several papers also to be delivered on that occasion.

MEN

IN CHEMICAL ENGINEERING

JOHN S. SHAW, manager of the extensive safety and service department of Hercules Powder Company, Wilmington, Del., has been elected chairman of the Chemical Section of the National Safety Council. At the same time the following further appointments in the Chemical Section were made: vice-chairman, JOHN ROACH, Department of Labor, Newark, N. J.; vice-chairman, A. L. ARMSTRONG, Eastman Kodak Co., Rochester, N. Y.; secretary, H. B. MOUGEY, General Motors Research Laboratory, Detroit, Mich.; chairman in charge of posters, slides, and safety kinks, GEORGE H. MILLER, DuPont Company, Wilmington, Del.; chairman



JOHN S. SHAW

of membership committee, JOE M. McVEY, Hercules Powder Company, Wilmington, Del.; chairman of publicity committee, S. D. KIRKPATRICK, *Chem. & Met.*, New York; chairman statistics committee, IRA V. KEPNER, Pennsylvania Salt Manufacturing Company, Philadelphia; and an executive committee consisting of L. A. DEBLOIS, C. F. WHITTEMORE, S. E. CLANCY, H. L. MINER, F. H. WHITING, FRED. L. ROSSELAND, and E. J. SMITH.

G. P. MILLS, for the past eight years chief engineer of the Duralloy Company, has been made director of the chrome alloy department of the General Alloys Company. After graduation from the University of Pennsylvania, Mr. Mills was engaged for several years on construction work and then went with the Koppers Company.

HARRY E. SMITH has resigned from Devoe & Reynolds to take a position in the research laboratory of Foster D. Snell, Brooklyn, N. Y.

DAVID R. MERRILL, assistant manager of research for the Union Oil Company

since June, 1926, has been advanced to the position of manager of research, replacing W. A. Raine, who has resigned.

K. G. CLARK has resigned from his position at the Fixed Nitrogen Research Laboratory to accept an instructorship in chemical engineering at Yale University.

C. D. LOWRY, JR., research chemist of the Universal Oil Products Company since 1927, has been elected secretary of the petroleum division, the American Chemical Society. Dr. Lowry, who studied at Northwestern University, Harvard, and in Germany, and taught at Leland Stanford, was research chemist with the Institute of American Meat Packers before joining his present company.

E. B. SWANSON has been promoted to chief economist of the Division of Petroleum Economics of the U. S. Bureau of Mines, where he has been acting chief since October, 1928.

JOHN J. CONE, president of Robert W. Hunt Company, engineers, and a member of that company since its organization in 1888, has retired and will be succeeded by C. B. Nolte, vice-president and general manager.

FRANCIS MACDONALD, formerly director of research of the American Potash & Chemical Corporation at Trona, Calif., and more recently with the DuPont company, has returned to Trona to again assume charge of research.

C. R. WAGNER, chief chemist for the Pure Oil Company, has been elected chairman of the petroleum division of the American Chemical Society for the coming year.

CALENDAR

AMERICAN CHEMICAL SOCIETY, 81st meeting, Indianapolis, March 30-April 30, 1931.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, New Orleans, Dec. 8-10.

AMERICAN PETROLEUM INSTITUTE, 11th annual meeting, Chicago, Nov. 10-13.

AMERICAN ENGINEERING COUNCIL, Administrative Board Meeting, Washington, Oct. 17-18.

ELECTROCHEMICAL SOCIETY, spring meeting, Birmingham, Ala., April 23-25, 1931.

SOCIETY OF INDEPENDENT ENGINEERS, Washington, Oct. 15-17.

HARRY WARNER, for the past five years on the staff of the soil improvement committee of the National Fertilizer Association, has resigned to join the Barrett Company for promotional work on fertilizer nitrogen products. Up to 1925, Mr. Warner was connected with the Iowa State College, Ames, for nine years, mainly at its agricultural experiment station.

PER K. FROLICH, engaged in research work for the petroleum hydrogenation plant of the Standard Oil Development Company, has been selected to receive the Grasselli medal by the American Section of the Society of Chemical Industry for his work on synthesis under high



pressure. The presentation* of the medal will be made in New York on Nov. 7, when Prof. W. K. Lewis, of Massachusetts Institute of Technology, will speak on the accomplishments of the medalist, his former colleague.

R. L. UPSHUR, JR., for a number of years with the Armour Fertilizer Works, has now become manager of the fertilizer materials division of the Victor Chemical Works, Chicago.

T. E. LAYNG, formerly associate professor in chemical engineering at the University of Illinois, is now assistant director of research and development for the United States Gypsum Company, Chicago.

C. T. HALSTEAD, formerly with the Rubberoid Company, has been placed in charge of research at the Headley Emulsified Products, Inc. A graduate of Yale in 1913, he spent some time afterward teaching there and in China.

CHARLES WADSWORTH, 3d, former managing editor of *Chem. & Met.* and later market research director of Batten, Barton, Durstine & Osborn, is now director of sales and advertising of the American Lead Pencil Company, Hoboken, N. J.

EDWARD A. RYCKENBOER has been elected a member of the board of the Roessler & Hasslacher Chemical Company, New York, to fill the post left vacant by the resignation of George F. Hasslacher. Dr. Ryckenboer was graduated from the University of Rochester in 1912, and later taught until 1917 at the University of Michigan, where he

also received his Ph.D. degree. He joined his present company as research chemist at Niagara Falls, and ultimately advanced to general superintendent of that plant.

BASILE W. DELGASS has resigned his position as vice-president of the Amtorg Trading Corporation, in charge of the oil and chemical department, to open a consulting office with M. C. Antonoff, his former assistant in the Amtorg connection, under the name of Amrusco.

LOUIS A. MIKESKA has left the Rockefeller Institute to join the research laboratories of the Standard Oil Development Company, Elizabeth, N. J., for work on the heavy hydrocarbons.

WALTER M. SCOTT has joined the consulting organization of Gustavus J. Esselen at Boston, to devote himself to textile chemistry and technology. After completing his education at Yale in 1915, Dr. Scott organized the technical department of Cheney Brothers and served as its director for over ten years. Later he was technical adviser to sales of the National Aniline & Chemical Company.

CHARLES E. NELSON has resigned from the DuPont Ammonia Corporation to join the laboratory of the Dow Chemical Company, Midland, Mich.

J. T. FETHERSTON has been elected president of the Selden Company to succeed J. M. Selden, who has retired. Mr. Fetherston has been engaged in engineering work for the City of New York and more recently was active with the American Cyanamid Company in the building of the Muscle Shoals Nitrate Plant and other activities.

JOHN BUXTON has joined the chemical department of the Du Pont Ammonia Corporation, Wilmington, Del. Mr. Buxton was graduated in chemical engineering from the California Institute of Technology and from the Massachusetts Institute of Technology. He was employed until recently as chemical engineer by the American Potash & Chemical Corporation, Trona, Calif.

S. D. LANGRECK has been promoted from plant superintendent to manager of the Monsanto (Ill.) plant of the Monsanto Chemical Works, succeeding L. S. Nickell, who since August has been in charge of the Monsanto Chemical Company, Ltd., the English subsidiary.

HAROLD J. PAYNE, since last fall on the staff of the Associated Business Papers, has been made assistant managing director of that association. A graduate of Massachusetts Institute of Technology, Mr. Payne was for several years on the editorial staff of *Chem. & Met.*, and subsequently was secretary of the American Leather Producers' Association for two years.

HERMANN SUIDA, professor of chemical engineering at the Vienna Institute of Technology and consulting chemical engineer for the I. G. Farbenindustrie A.G., returned to Europe on Oct. 8,

after spending several weeks in this country studying domestic wood distillation technology.

J. F. WALSH, vice-president in charge of research of the Celluloid Corporation, has taken charge of a new department of industrial research with headquarters at New York. He will remain advisor to the research and development department.

ARTHUR E. PETERSEN, formerly assistant works manager of the Celluloid Corporation, has been appointed technical director of the company in charge of development and research.

OBITUARY



DR. HERBERT H. DOW died suddenly on October 15 following a serious operation at Rochester, Minn. News of this great loss to the chemical industry and profession reached New York just as this issue goes to press. A more adequate appreciation of Dr. Dow's character and achievements must be postponed until next month.

C. G. MEMMINGER, president of the Coronet Phosphate Company and for many years an outstanding figure in the phosphate industry, died at his home in Asheville, N. C., on Aug. 13. Mr. Memminger was born Aug. 10, 1864, at Flat-rock, N. C., and attended the University of Virginia, where he was a graduate from the engineering department. He later achieved international reputation as a mining engineer, and was one of the pioneers in the Florida pebble phosphate fields, recognizing the great future of these deposits. He built and operated many of the successful plants in this region, but was also deeply interested in chemical research, developing the process for raising the grade of pebble phosphate by calcination. Fully aware of changing conditions, he became interested in the furnace processes for producing phosphoric acid; and, although in failing health for the past few years, he undertook its commercial development, so that at the time of his death he had just completed a large plant which will shortly be put in operation.

CHARLES L. PATTERSON, retired vice-president and director of the DuPont company, died on Aug. 19 of a heart

attack at his home at Chadds Ford, Pa. He had been with the company 33 years and had become vice-president in 1907.

CLIFFORD B. BELLIS, head of the flow meter division of the Foxboro Company and formerly assistant editor of *Chem. & Met.*, died on Sept. 7, at his home in Mansfield, Mass. Mr. Bellis was born in 1896 at Waltham, Mass., and attended the Massachusetts Institute of Technology for three years before enlisting for military service in 1917. After a year's work concluded by the armistice, he engaged in sales work on the application of steel and furnaces. In 1924 he became assistant editor of *Chem. & Met.*, which he left later to devote himself to industrial instrumentation. For a year he was with the Bristol Company, and in 1928 attained the position which he held at the time of his death.

RICHARD K. MEADE, who maintained a consulting chemical engineering practice in Baltimore, died in that city on Oct. 13 at the age of 55. Born at Charlottesville, Va., in 1874, Mr. Meade was educated at the University of Virginia and at Lafayette College, where he was later instructor in chemistry.



He left there in 1902 to begin on a long career specializing in consulting work for the cement, lime, and plaster industries. At the same time he was editor of *The Chemical Engineer* from 1904 to 1910, devoting much energy to the formation of the American Institute of Chemical Engineers, of which he became a charter member. He was vice-president of the organization from 1912 to 1914. During the War his interests lead him into processes for alkali recovery in cement plants and later he built plants for the production of barium and strontium compounds. Various cement and lime plants throughout the country are a testimony to his technical work.

FRANK L. DRIVER, SR., chairman of the board of directors and one of the founders of the Driver-Harris Company, Harrison, N. J., died in Belgium on Aug. 26, 1930, after residing there for the past five years, due to ill health. Mr. Driver was born in Brooklyn in 1870 and until 1925 was president of the company he founded.

MARKET APPRAISAL OF CHEMICAL INDUSTRY

REPORT of Duval Texas Sulphur Company for the period Oct. 1, 1929, to Aug. 31, 1930, shows net profit, including \$10,314 profit from sale of capital assets, of \$241,855 after taxes, interest, depreciation and depletion, equivalent to 48 cents a share on 500,000 no-par shares of capital stock. Gross for the period was \$920,318.

Pennsylvania Salt Manufacturing Company for year ended June 30, 1930, reports net income of \$1,195,998 after depreciation, depletion, development and research reserve, and federal taxes, equivalent to \$7.97 a share on 150,000 shares of stock. This compares with \$1,495,939 or \$9.97 a share in preceding year.

Special meeting of stockholders of Abbott Laboratories, Inc., has been called for Oct. 21 to vote on proposal to increase capital stock to 200,000 shares from 150,000 shares, and to vote on proposed increase in directorate to eleven members from nine.

For the seven months ended July 31, the American Zinc, Lead & Smelting Company has reported a profit of \$272,144, after interest, depreciation and depletion, but before federal taxes.

Annual report of the Davison Chemical Company, Baltimore, shows a net income for the fiscal year ended June 30 totaling \$2,036,486 after all charges, including income taxes. This is equivalent to \$4.04 a share on the 504,067 shares of common stock outstanding, and compares with \$1,643,434, or \$3.34, computed before federal income taxes on operations during the fiscal year ended June 30, 1929.

Merck & Co., operating subsidiary of the Merck Corporation, has called for redemption as of Oct. 1 a total of \$300,000 of its first mortgage 6 per cent bonds. The total outstanding funded debt of the company will now be \$900,000, having been reduced in three years from \$2,700,000, which amount was issued at the time of the acquisition, July, 1927, of the business of Powers-Weightman-Rosengarten.

The Houston Oil Company of Texas has applied for listing on the New York Stock Exchange of 1,100,000 voting trust certificates to represent the new \$25 par value common stock. This follows the splitting up of the old \$100 par value shares on a four for one basis.

The International Printing Ink Company, this city, has acquired the business and assets of the J. R. Curtis Company, Atlanta, and also that of R. A. Barlett & Earle, Ltd., England. The last-mentioned has been combined with the International company's British subsidiary, Ault & Wiborg, Ltd.

For the six months ended June 30 the United Dyewood Corporation has reported a consolidated net income totaling \$176,210, after all charges and federal taxes. This was equal, after cumulative preferred dividend requirements, to 3 cents a share earned on the 139,183 shares of common stock outstanding, and compared with a net of \$176,210, or 27 cents a common share, for the corresponding period of 1929.

Price Range 1930		Stock	Price Range in September	
High	Low		Sept. 2	Low Sept. 30
34	16	Agfa Anasco Corp.	125	104
156	103	Air Reduction	128	105
2	1	Ajax Rubber	1	1
343	232	Allied Chemical	274	235
356	185	Aluminum Co.	239	190
10	2	Am. Ag. Chemical	5	3
33	9	Am. Commercial Alcohol	15	14
37	12	American Cyanamid, B.	19	12
7	2	American Hide & Leather	3	3
51	21	American Metals	29	22
22	5	Am. Solvents & Chemical	7	5
43	15	Anglo-Chile Nitrate	29	19
29	19	Archer-Daniels-Midland	21	19
8	3	Armour, Ill., A.	5	4
51	24	Atlantic Refining	33	25
106	62	Atlas Powder	71	63
70	49	Beechnut Packing	59	54
35	28	California Petroleum	28	28
20	12	Celluloid Corp.	20	16
15	5	Certain-teed	6	5
32	16	Chickasha Cotton Oil	17	16
64	50	Colgate-Palmolive-Peet	59	56
199	108	Columbian Carbon	139	114
38	20	Commercial Solvents	27	21
111	78	Corn Products	94	78
43	18	Davison Chemical	29	20
42	19	Devos & Reynolds A.	24	19
100	65	Dow Chemical	69	65
145	95	Du Pont	120	103
123	114	Du Pont, 6 pc. deb.	123	122
21	5	Duval Texas Sulphur	6	5
255	175	Eastman Kodak	218	195
33	18	Firestone Tire	21	18
5	1	Fisk Rubber	1	1
53	37	Freepont Texas	44	39
71	36	General Asphalt	41	36
38	13	Glidden	17	13
47	34	Gold Dust	42	36
58	19	Goodrich Co.	23	19
85	60	Hercules Powder	75	66
23	11	Heyden Chemical	11	11
116	52	Houston Oil	76	55
7	4	Imperial Chemical Ind.	4	4
124	73	Industrial Rayon	86	76
8	4	Int. Ag. Chemical	6	4
44	19	International Nickel	24	19
18	5	International Paper, C.	8	5
45	34	International Salt	39	36
25	14	Kellogg, Spencer & Sons	16	14
6	1	Kelly-Springfield	3	2
11	4	Lee Rubber & Tire	4	4
36	22	Lehn & Fink	27	23
31	17	Libby-Owens	19	17
81	52	Liquid Carbonic	70	59
37	14	McKesson & Robbins	17	14
51	32	Mathieson Alkali	42	35
63	30	Monsanto Chemical	47	33
39	24	Nat'l Distillers Products	31	27
139	119	National Lead	136	120
91	62	New Jersey Zinc	65	65
32	22	Ohio Oil	30	23
60	40	Owens-Ill. Glass	47	40
44	24	Phillips Petroleum	34	24
57	45	Pittsburgh Plate Glass	49	48
78	52	Pratt & Lambert	74	68
27	16	Procter & Gamble	20	16
85	74	Pure Oil	75	75
34	10	Sherwin-Williams	15	11
32	16	Silica-Gel	21	16
42	22	Sinclair Oil	27	23
75	54	Skelly Oil	60	55
84	57	Standard Oil, Cal.	69	57
40	26	Standard Oil, N. J.	31	26
70	50	Standard Oil, N. Y.	59	54
10	5	Sun Oil	5	5
34	28	Swan & Finch	31	28
17	8	Swift & Co.	12	9
60	43	Tennessee Copper & Chemical	51	44
67	48	Texas Corporation	58	54
17	10	Texas Gulf Sulphur	13	10
106	60	Tidewater Assoc. Oil	78	65
50	33	Union Carbide	40	34
84	40	Union Oil, Cal.	51	40
139	59	United Carbon	66	61
15	7	U. S. Industrial Alcohol	8	7
35	14	U. S. Leather	20	14
97	66	U. S. Rubber	78	68
143	49	Vacuum Oil	82	57
8	2	Vanadium Corp.	4	3
29	22	Va.-Car. Chemical	27	24
59	30	Wesson Oil	39	31
7	2	Westvaco Chlorine	3	2
		Wilson & Co.		

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Distribution of Chemicals Gains In Volume

Consuming Industries Call More Actively for Contract Shipments

SHIPPING instructions for deliveries of chemicals against running contracts have been more numerous in the last month. Consuming industries appear to be operating on a more regular basis. Spotted conditions, however, still prevail, so that the increased movement of raw materials cannot be described as more than seasonal, especially in view of the relatively quiet condition of the market during the summer period. The glass, soap, paint, and textile trades are included among the consuming industries which have been taking chemicals in greater volume during the last month.

Petroleum refining, which was on an unusually high level in the latter half of last year, is falling behind at present, owing to restrictions placed on production of crude.

Sugar refining, likewise, has suffered in comparison with activities of a year ago. Latest available figures place the melt of 15 refiners from Jan. 1 to Aug. 23 at 3,135,000 long tons, compared with 3,430,000 long tons for the comparable period of last year.

Consumption of crude rubber by manufacturers in the United States for the month of August is estimated at 30,575 long tons by the Rubber Manufacturers' Association. This is an increase of 4.6 per cent over the July consumption of 29,245 long tons and compares with 38,274 long tons in August, 1929, and 42,927 long tons in August, 1928.

RUNNING through the various industries which are consumers of chemicals, it will be found that the outlet for raw materials has been narrowed this year by close to 10 per cent. This, however, does not take into consideration any comparison of stocks in the hands of consumers. According to reports, supplies on hand are far below normal and the small inventories carried are pointed out as a condition favorable to an increased buying movement in the near future.

Furthermore, the falling off in the movement of chemicals which took place in the last two months of 1929 makes it improbable that the last quarter of this year will suffer much in compari-

son with the final quarter of last year.

The Atlantic States Shippers' Advisory Board, in a report based on car requirements, anticipates a decline of 2.2 per cent in the movement of chemi-

Bankers Foresee Era Of New Prosperity

At the convention of the Investment Bankers' Association held this week at New Orleans, the president of the association said:

"We should now be laying the foundation for a better, a more even, and a sounder era of prosperity than ever before. The orgy of speculation which clouded the country's vision has passed and clearer thinking is now the rule rather than the exception.

"Old-fashioned standards for judging values are again back in vogue and as investment bankers we can do our part to direct the savings of the country into constructive and dependable lines. While speculation has its proper and important function in our economic life, after all, the backlog of prosperity is the savings and sound investments of the people.

"Savings are increasing and prices for high-grade bonds are improving. Our leading industries are in a sound financial and operating condition. Manufactured inventories are below the average. All these, together with our wealth and natural resources and the efficiency and normal energy of our people, are factors of strength on which to build a new period of prosperity."

.....
cals for the quarter, as compared with the October-December period of last year. If this estimate proves to be approximately correct, consumption of chemicals for this year, while lower

than in 1929, will compare favorably with that for any other preceding year.

AN INCREASE in September, as compared with August, of 1 per cent in employment and 1.4 per cent in payrolls, based on returns from 40,775 establishments in thirteen major industrial groups, has just been announced by the Bureau of Labor Statistics. The decreases from July to August were 1.4 per cent in employment and 2.6 in earnings.

Of the three largest manufacturing industries, drops of 1.4 per cent in iron and steel and 2.7 per cent in motor vehicles were shown, while textiles showed an increase in employment of 2.1 per cent.

Of the thirteen major industrial groups, manufacturing industries alone continued to show a decrease in employment, which was only 0.03 per cent from August to September, as against 2.1 per cent from July to August. Payroll totals increased 0.4 per cent, as against the decrease of 2.6 per cent reported in the previous month.

In September the manufacturing establishments reporting had 2,929,079 employees, whose combined earnings in one week were \$72,258,248, while in August the employees numbered 2,941,246, with a weekly payroll total of \$71,896,678.

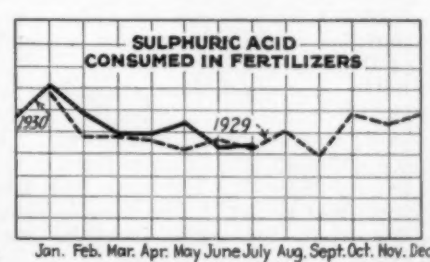
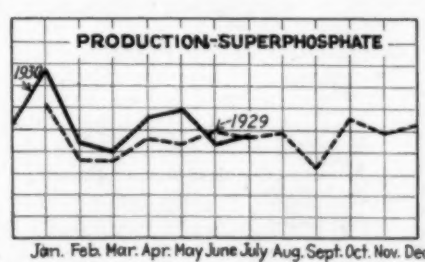
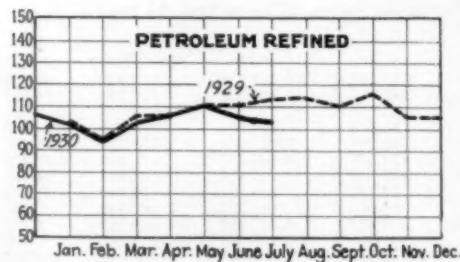
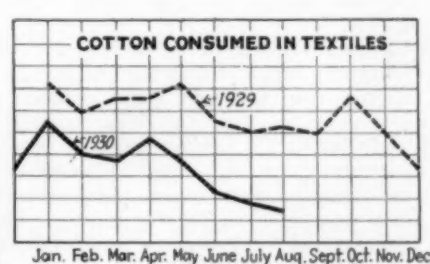
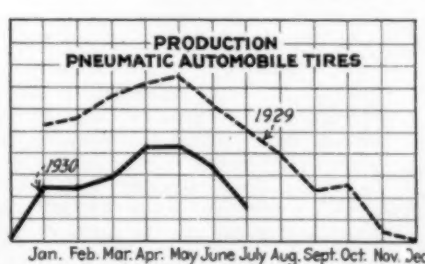
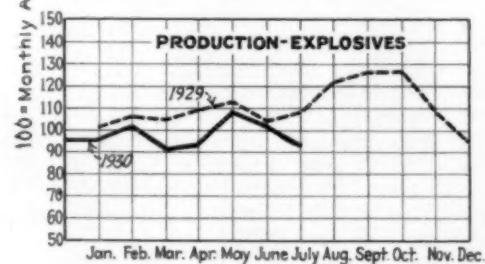
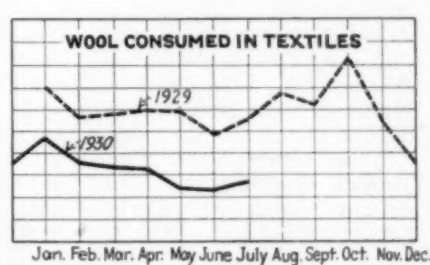
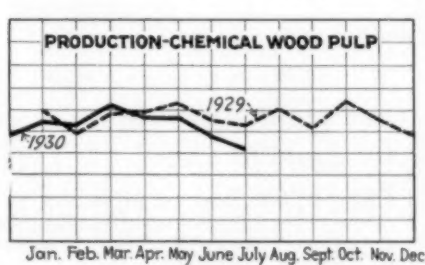
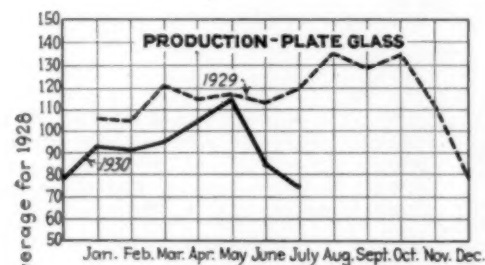
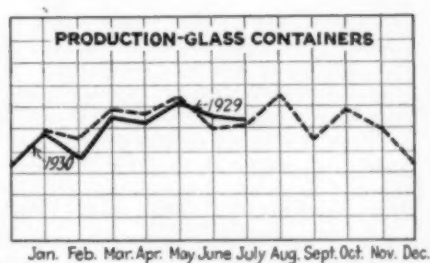
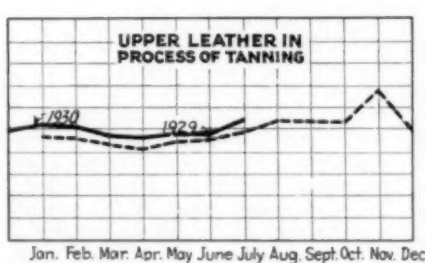
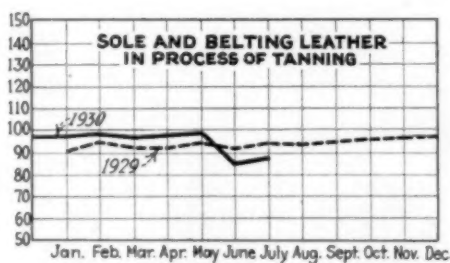
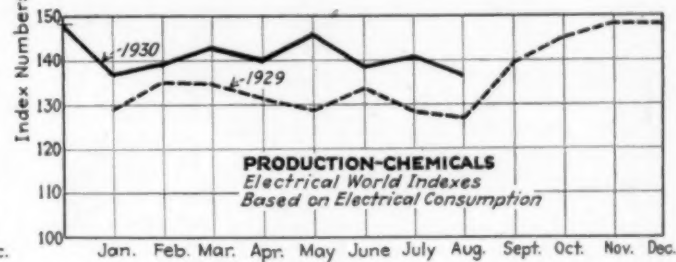
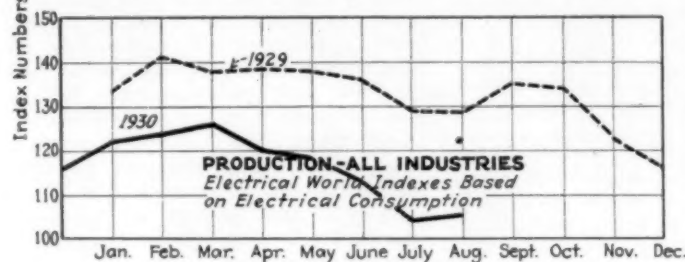
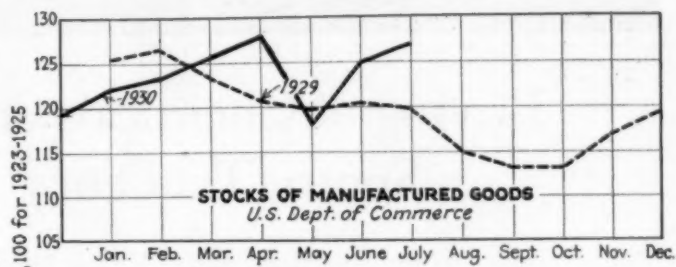
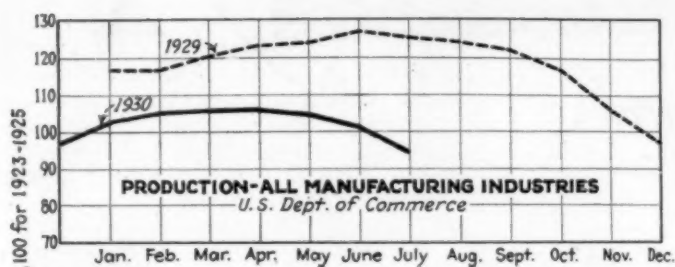
Substantially increased employment was shown in September in the food, textile, chemical, and tobacco groups. Among the decreases in the remaining groups of manufacturing industries were drops of 3.2 per cent in lumber, 2.7 per cent in vehicles, and 1.4 per cent in the iron and steel group.

The New England, Middle Atlantic, and South Atlantic divisions had more employees in September than in August, while the remaining six divisions reported fewer employees.

Per capita earnings in September were 0.6 per cent greater than in August and 9.9 per cent smaller than in September, 1929.

IN the market for vegetable oils, considerable interest was shown in the crop report, which estimated condition of flaxseed as of Oct. 1 at 60.4 per cent, yield per acre 5.7 bu., and estimated yield at 25,200,000 bu. This represents an increase of 600,000 bu. over the report for September. Prices for linseed oil were easy during the month, and at the lowest levels considerable business was placed. Later on, crushers put the quotation for oil in cooperage at 10c. per pound and buying interest died down.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



MARKET CONDITIONS AND PRICE TRENDS



Buying of Chemicals Shows Spotty Tendency

Some Selections Move Freely With
Quiet Demand for Others

IMPROVEMENT in demand for chemicals has been reported in recent weeks and material gains have been recorded in deliveries to consuming trades in the last month. New buying, however, has shown an irregular trend. In some cases orders have been placed for quantity lots while other selections have met with a continuance of hand-to-mouth buying. Shipping instructions against existing contracts have been more numerous, but new buying for forward positions has not come up to expectations.

Considerable interest has been manifested in forthcoming contract prices for alkalis covering delivery over next year. Some producers have quoted on direct inquiries but have refrained from announcing any general price level. New prices, however, are anticipated in a few days, and, according to rumors, they will be lower than the prices in effect from 1930 deliveries.

During the month the metal markets declined in price and lower sales schedules went into effect on the lead, copper, and tin salts. Toward the close of the period acetate of lime was marked down in price, and this was followed by a downward revision of acetic acid prices. With these exceptions the market for chemicals held a fairly steady position.

THE position of acetate of lime has been weak for some time. Production for the first eight months of this year was 65,539,804 lb., compared with 94,184,074 lb. for the corresponding period of 1929, but shipments for the same period were 43,110,014 lb. this year and 93,384,008 lb. last year. Stocks at the close of August amounted to 30,037,870 lb., as against 1,259,161 lb. on Aug. 31, 1929. These statistics explain the present weakness of this chemical.

The new regulations governing sale and distribution of industrial alcohol have not yet gone into force. The original plan was to make them operative on Sept. 1. The date was later postponed to Oct. 1, but latest information from Washington is to the effect that the new rules will not be put into force before the first of next year,

although more definite information should be available very shortly.

EXPORTERS of chemicals have been weighing the probable effect on shipments of chemicals to Canada of recent changes in tariffs adopted by that country. Under the new rates salt cake is dutiable at one-half cent per pound. Casein, in addition to a 25 per cent ad valorem inpost, must carry an additional specific duty of 2½c. per pound. Fertilizer materials remain on the free list, but manufactured fertilizers carry a duty of 10 per cent under the general classification. The seven large fertilizer plants which are operating in British Columbia are expected to benefit very materially from the new tariff schedule.

In connection with tariff changes it is of interest to note that a cable to

the Department of Commerce states that the Japanese government is considering an increase in the present import duty on soda ash, due to alleged dumping from abroad.

Another development in foreign markets is found in a report from Sicily which states that the obligatory consortium for the Sicilian sulphur industry originally legalized July 15, 1906, and extended by decrees to June 31, 1930, was again approved for extension by the Cabinet of Ministers in March, 1930. The bill embodying this approval was made law July 10, 1930, for another 10-year period. The decree of Aug. 5, 1927, which reduced royalties in kind or in money payable to concessionaires and subconcessionaires 33 per cent is extended to July 31, 1934. An autonomous technical mining section is created by the new law to promote and facilitate improved technique in mining and working the ore, and to organize and conduct research work and surveys for new sulphur deposits in Sicily.

Domestic producers of sulphur have found a wider outlet for their product this year as far as home trade is concerned but export shipments have fallen below the totals of a year ago.

Sales and Distribution Of Lime in 1929

THE lime sold by producers in the United States in 1929 amounted to 4,269,768 short tons, valued at \$33,478,848, according to figures obtained from a compilation of reports made by lime manufacturers to the U. S. Bureau of Mines, Department of Commerce. This represents a decrease of 4 per cent in quantity and of 8 per cent in value as compared with 1928. Sales of hydrated lime, which are included in these figures, amounted to 1,550,771 tons, valued at \$12,771,525, a decrease of 4 per cent in quantity and of

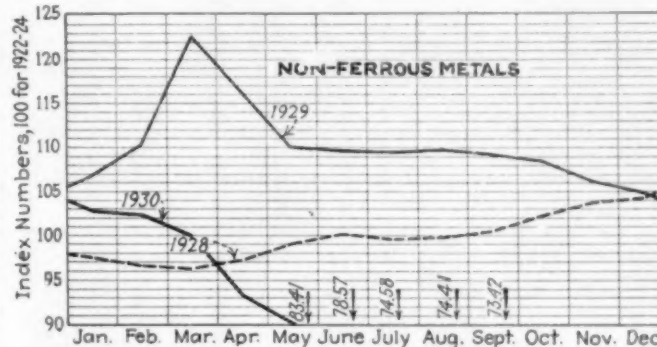
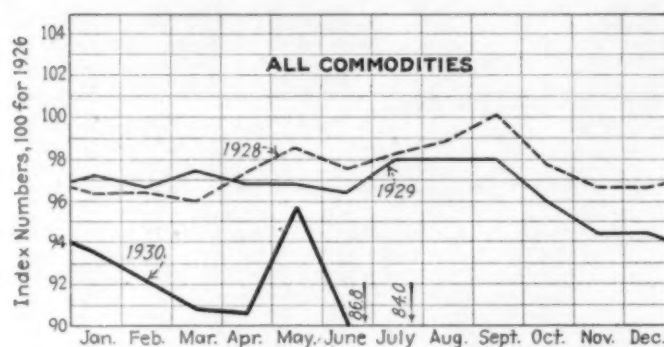
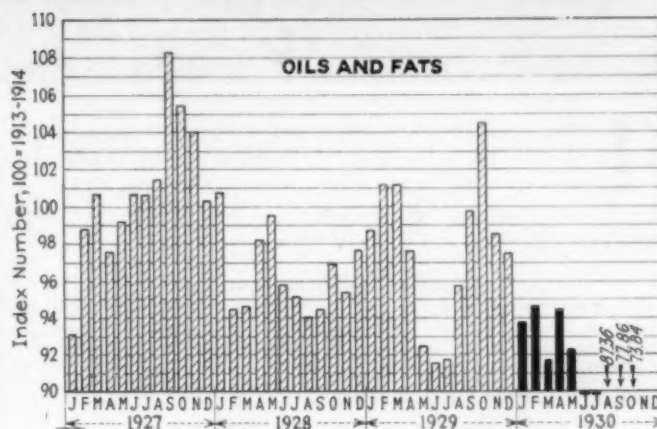
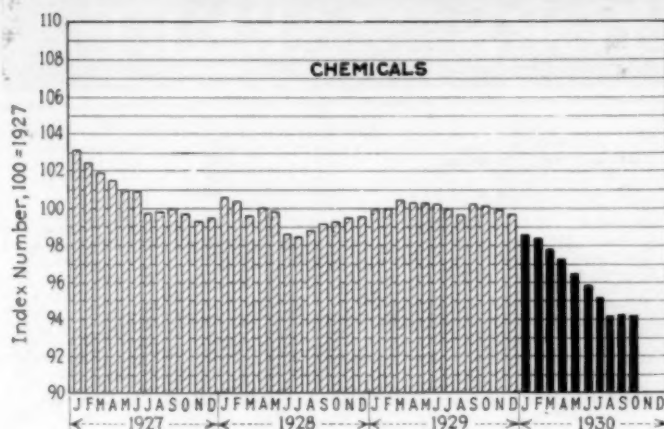
6 per cent in value. The average unit value of all lime showed a decrease from \$8.18 a ton in 1928 to \$7.84 in 1929, and that of hydrated lime a decrease from \$8.40 a ton in 1928 to \$8.24 a ton in 1929.

Sales of lime used in the manufacture of chemicals—2,290,612 tons, valued at \$16,787,408—increased 7 per cent in quantity; lime sold for construction—1,640,827 tons, valued at \$14,303,539—decreased 17 per cent in quantity; and that sold for agricultural purposes—338,329 tons, valued at \$2,387,901—increased 1 per cent in quantity. The following table shows sales of lime by uses in 1928 and 1929:

Lime Sold by Producers in the United States, 1928 and 1929, by Uses

Use	1928		1929	
	Short Tons	Value	Short Tons	Value
Agricultural.....	333,910	\$2,287,558	338,329	\$2,387,901
Building.....	1,986,465	17,706,420	1,640,827	14,303,539
Chemical:				
Glass works.....	76,161	588,305	75,283	544,760
Metallurgy.....	504,248	3,055,081	578,488	3,258,992
Paper mills.....	429,334	3,260,733	411,017	3,057,350
Refractory lime (dead-burned dolomite).....	448,761	4,283,036	488,032	4,261,942
Sugar refineries.....	22,678	280,186	20,758	249,190
Tanneries.....	64,464	494,983	67,046	516,207
Other uses.....	592,391	4,493,333	649,988	4,898,967
Total chemical.....	2,138,037	\$16,455,657	2,290,612	\$16,787,408
Hydrated lime (included in above totals).....	4,458,412	\$36,449,635	4,269,768	\$33,478,848
Hydrated lime (included in above totals).....	1,612,818	\$13,540,215	1,550,771	\$12,771,525

CHEM. & MET. *Weighted Indexes of PRICES*



U. S. Department of Labor

Engineering & Mining Journal

Weighted Index Number for Chemicals Declines

THE majority of price changes in the chemical market in the last month were in favor of lower levels. Lead and copper salts were influenced by the lower position of the metal market, and the same was true of the tin salts. Acetate of lime has accumulated in sellers' hands and reduced prices were regarded as an attempt to regain a portion of its lost market. The price movement for acetic acid was directly traceable to the weakened position of acetate of lime. In addition, there are expectations that new and lower contract prices for alkalis will soon be announced.

In the face of this record of revised

quotations it seems contradictory to assert that the chemical market as a whole underwent but little change during the month, yet the greater part of the chemical list held a steady price course and higher quotations prevailed for sulphate of ammonia, nitrate of soda, and diethylene glycol. Different producers maintain that current values are too low to warrant belief in further reductions except in the case of selections which may be affected by special conditions such as, for instance, a further drop in metal prices, which might be passed on to the metal derivatives.

A factor which may have an important bearing on future values is found in the volume of stocks in the hands of sellers and consumers. Producers are now advocating an inventory of such stocks. It is believed that consumers are not carrying surplus stocks and long-continued restrictions of outputs are thought to place producers in a favorable position. In other words, production has been held close to consuming demands and any active buying movement would place a premium on goods for prompt and nearby shipment.

On the other hand, it is not probable that heavy buying will be sustained over the remainder of this year and price

movements of importance probably will be lacking.

With regard to reduced contract prices for alkalis, any such outcome would be at least partly discounted by the fact that the open quotations for a long time have been an indication rather than an absolute trading level. A reduction in the open prices, therefore, would consist largely in bringing quotations and actual trading basis on a closer footing.

While values for vegetable oils and fats have steadily declined, it is difficult to interpret the present level, as stocks are large and under a quiet buying movement, competitive influences are encouraged. Values for oils, also, are governed somewhat by world, rather than local, conditions and European as well as Oriental markets are not showing any real stability.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	94.13
Last month	94.38
October, 1929	100.13
October, 1928	99.30

While the large majority of chemicals underwent no quotable changes in price, the easier position of salt cake and lower sales levels for turpentine brought a reduction in the index number. Lead oxides and copper sulphate also were reduced in price.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	73.84
Last month	77.86
October, 1929	104.50
October, 1928	96.97

An easy price tone existed in the market for oils and fats. Cottonseed, linseed, coconut, corn, China wood, and oleo oils sold at reduced price levels. Crude menhaden oil sold down to 20c. per gallon at shipping points.

CURRENT PRICES

in the NEW YORK MARKET

THE following prices refer to round lots in the NEW York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Oct. 14.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	\$0.11-\$0.12	\$0.11-\$0.12	\$0.14-\$0.15
Acid, acetic, 28%, bbl., cwt.	2.73-2.88	3.11-3.26	3.88-4.03
Glacial 99%, tanks.	10.76	10.76	10.76
drc.	11.01-11.26	11.01-11.26	11.01-11.26
U. S. P. reagent, c'ys.	11.51-11.76	11.51-11.76	11.51-11.76
Boric, bbl., lb.	.061-.07	.061-.07	.061-.07
Citric, kegs, lb.	.46-.47	.46-.47	.46-.47
Formic, bbl., lb.	.10-.11	.10-.11	.101-.11
Gallie, tech., bbl., lb.	.50-.55	.50-.55	.50-.55
Hydrofluoric 30% carb, lb.	.06-.07	.06-.07	.06-.07
Latic, 44%, tech., light, bbl., lb.	.111-.12	.111-.12	.111-.12
22%, tech., light, bbl., lb.	.051-.06	.051-.06	.051-.06
Muriatic, 18%, tanks, cwt.	1.00-1.10	1.00-1.10	1.00-1.10
Nitric, 36%, carboys, lb.	.05-.051	.05-.051	.05-.051
Oleum, tanks, wks., ton.	18.50-20.00	18.50-20.00	18.50-20.00
Oxalic, crystals, bbl., lb.	.11-.111	.11-.111	.11-.111
Phosphoric, tech., c'ys., lb.	.081-.09	.081-.09	.081-.09
Sulphuric, 60%, tanks, ton.	11.00-11.50	11.00-11.50	11.00-11.50
Tannic, tech., bbl., lb.	.35-.40	.35-.40	.35-.40
Tartaric, powd., bbl., lb.	.34-.36	.34-.36	.38-.39
Tungstic, bbl., lb.	1.40-1.50	1.40-1.50	1.30-1.40
Alcohol, ethyl, 190 p'f., bbl., gal.	2.63-.271	2.63-.271	2.68-.271
Alcohol, Butyl, tanks, lb.	.161-.17	.161-.17	.161-.17
Alcohol, Amyl			
From Pen'ane, tanks, lb.	.236	.236	.236
Denatured, 188 proof			
No. 1 special dr., gal.	.40	.40	.51
No. 5, 188 proof, dr., gal.	.40	.40	.51
Alum, ammonia, lump, bbl., lb.	.031-.04	.031-.04	.031-.04
Chromic, bbl., lb.	.05-.051	.051-.051	.051-.06
Potash, lump, bbl., lb.	.031-.04	.031-.04	.021-.031
Aluminum sulphate, com., bags, cwt.	1.40-1.45	1.40-1.45	1.40-1.45
Iron free, bg., cwt.	1.90-2.00	1.90-2.00	2.00-2.10
Aqua ammonia, 26%, drums, lb.	.03-.04	.03-.04	.03-.04
tanks, lb.	.021-.021	.021-.021	.021-.021
Ammonia, anhydrous, cyl., lb.	.15	.15	.14
tanks, lb.	.051	.051	.051
Ammonium carbonate, powd.			
tech., casks, lb.	.101-.11	.101-.11	.12-.13
Sulphate, wks., cwt.	1.85	2.22	2.10
Amylacetate tech., tanks, lb., gal.	.222	.222	.222
Antimony Oxide, bbl., lb.	.081-.10	.081-.10	.09-.10
Arsenic, white, powd., bbl., lb.	.04-.041	.04-.041	.04-.041
Red, powd., kegs, lb.	.09-.10	.09-.10	.09-.10
Barium carbonate, bbl., ton.	58.00-60.00	58.00-60.00	58.00-60.00
Chloride, bbl., ton.	63.00-65.00	63.00-65.00	64.00-70.00
Nitrate, cask, lb.	.07-.071	.07-.071	.08-.081
Blanc fixe, dry, bbl., lb.	.031-.04	.031-.04	.04-.041
Bleaching powder, f.o.b., wks., drums, cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Borax, bbl., lb.	.033-.033	.033-.033	.021-.03
Bromine, ca., lb.	.45-.47	.45-.47	.45-.47
Calcium acetate, bags.	2.25	3.00	4.50
Arsenate, dr., lb.	.07-.08	.07-.10	.061-.07
Carbide drums, lb.	.05-.06	.05-.06	.051-.06
Chloride, fused, dr., wks., ton.	20.00	20.00	20.00
flake, dr., wks., ton.	22.75	22.75	22.75
Phosphate, bbl., lb.	.08-.081	.08-.081	.07-.071
Carbon bisulphide, drums, lb.	.051-.06	.051-.06	.05-.06
Tetrachloride drums, lb.	.061-.07	.061-.07	.061-.07
Chlorine, liquid, tanks, wks., lb.	.024	.024	.03
Cylinders.	.04-.06	.04-.06	.05-.08
Cobalt oxide, cans, lb.	2.10-2.20	2.10-2.20	2.10-2.25
Copperas, bags, f.o.b. wks., ton.	13.00-14.00	13.00-14.00	15.00-16.00
Copper carbonate, bbl., lb.	.09-.18	.09-.18	.22-.23
Cyanide, tech., bbl., lb.	.41-.46	.45-.46	.49-.50
Sulphate, bbl., cwt.	4.10-4.25	4.25-4.50	6.00-6.10
Cream of tartar, bbl., lb.	.26-.27	.26-.27	.271-.28
Diethylene glycol, dr., lb.	.14-.16	.11-.13	.10-.15
Epsom salt, dom., tech., bbl., cwt.	1.75-2.15	1.75-2.00	1.75-2.00
Imp., tech., bags, cwt.	1.15-1.25	1.15-1.25	1.15-1.25
Ethyl acetate, drums, lb.	.096	.096	.125
Formaldehyde, 40%, bbl., lb.	.071-.08	.071-.08	.081-.09
Furfural, dr., contract, lb.	.10-.12	.10-.12	.15-.17
Fusel oil, crude, drums, gal.	1.30-1.40	1.30-1.40	1.30-1.40
Refined, dr., gal.	1.90-2.00	1.90-2.00	2.50-3.00
Galubers salt, bags, cwt.	1.10-1.20	1.10-1.20	1.00-1.10
Glycerine, c.p., drums, extra, lb.	.13-.131	.13-.131	.14-.15
Lead:			
White, basic carbonate, dry casks, lb.	.071	.071	.09
White, basic sulphate, sek., lb.	.071	.071	.081
Red, dry, sek., lb.	.081	.09	.10
Lead acetate, white crys., bbl., lb.	.12-.13	.12-.13	.13-.14
Lead arsenate, powd., bbl., lb.	.13-.14	.13-.14	.13-.14
Lime, chem., bulk, ton.	8.50	8.50	8.50
Litharge, powd., csk, lb.	.071	.08	.091
Lithopone, bags, lb.	.051-.06	.051-.06	.051-.061
Magnesium carb., tech., bags, lb.	.06-.061	.06-.061	.061-.07

	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal.	.38	.38	.55
97%, tanks, gal.	.39	.39	.55
Synthetic, tanks, gal.	.401-.45	.401	
anti-freeze, 761%, tanks, gal.	.31	.31	
Nickel salt, double, bbl., lb.	.13-.131	.13-.131	.13-.131
Single, bbl., lb.	.13-.131	.13-.131	.13-.131
Orange mineral, csk., lb.	.101	.11	.121
Phosphorus, red, cases, lb.	.42-.44	.42-.44	.55-.57
Yellow, cases, lb.	.31-.32	.31-.32	.32-.33
Potassium bichromate, casks, lb.	.09-.091	.09-.091	.09-.091
Carbonate, 80-85%, calc., csk., lb.	.051-.06	.051-.06	.051-.06
Chlorate, powd., lb.	.081-.09	.081-.09	.071-.081
Cyanide, ca., lb.	.571-.58	.52-.55	.51-.53
Frat sorts, csk., lb.	.081-.09	.081-.09	.081-.09
Hydroxide (c'stic potash) dr., lb.	.061-.061	.061-.061	.061-.061
Muriate, 80% bgs., ton.	37.15	37.15	36.75
Nitrate, bbl., lb.	.06-.061	.06-.061	.06-.071
Permanganate, drums, lb.	.16-.161	.16-.161	.16-.161
Prussiate, yellow, casks, lb.	.181-.191	.181-.19	.19-.191
Sal ammoniac, white, casks, lb.	.046-.05	.046-.05	.047-.05
Salsoda, bbl., cwt.	.90-.95	.90-.95	.90-.95
Salt cake, bulk, ton.	15.00-18.00	18.00-20.00	18.00-20.00
Soda ash, light, 58%, bags, contract, cwt.	1.32	1.32	1.32
Dense, bags, cwt.	1.35	1.35	1.35
Soda, caustic, 76%, solid, drums, contract, cwt.	2.90-3.00	2.90-3.00	2.90-3.00
Acetate, works, bbl., lb.	.04-.05	.04-.05	.05-.051
Bicarbonate, bbl., cwt.	2.00-2.25	2.00-2.25	2.00-2.25
Bichromate, casks, lb.	.07-.071	.07-.071	.07-.071
Bisulphate, bulk, ton.	14.00-16.00	14.00-16.00	12.00-15.00
Bisulphite, bbl., lb.	.031-.04	.031-.04	.031-.04
Chlorate, kegs, lb.	.051-.071	.071-.08	.061-.061
Chloride, tech., ton.	12.00-14.75	12.00-14.75	12.00-14.00
Cyanide, cases, dom., lb.	.17-.18	.18-.22	.18-.22
Fluoride, bbl., lb.	.081-.09	.081-.09	.081-.09
Hyposulphite, bbl., lb.	2.40-2.50	2.40-2.50	2.50-3.00
Nitrate, bags, cwt.	2.02	1.99	2.10
Nitrite, casks, lb.	.071-.08	.071-.08	.071-.08
Nitrosyl, casks, lb.	.03-.031	.03-.031	.031-.031
Prussiate, dibasic, bbl., lb.	.111-.12	.111-.12	.111-.12
Silicate (30%, drums), cwt.	.60-.70	.60-.70	.75-1.15
Sulphide, fused, 60-62%, dr., lb.	.021-.031	.021-.031	.031-.04
Sulphite, cyrs., bbl., lb.	.03-.031	.03-.031	.021-.03
Sulphur, crude at mine, bulk, ton	18.00	18.00	18.00
Chloride, dr., lb.	.05-.06	.04-.05	.04-.05
Dioxide, cyl., lb.	.061-.07	.07-.08	.09-.10
Flour, bag, cwt.	1.55-3.00	1.55-3.00	1.55-3.00
Tin bichloride, bbl., lb.	nom.	nom.	.141
Oxide, bbl., lb.	.34	.36	.46
Crystals, bbl., lb.	.27	.271	.35
Zinc chloride, gran., bbl., lb.	.061-.061	.061-.061	.061-.061
Carbonate, bbl., lb.	.101-.11	.101-.11	.10-.11
Cyanide, dr., lb.	.41-.42	.40-.41	.40-.41
Dust, bbl., lb.	.071-.08	.08-.081	.09-.10
Zinc oxide, lead free, bag, lb.	.061	.061	.061
5% lead sulphate, bags, lb.	.061	.061	.061
Sulphate, bbl., cwt.	3.00-3.25	2.75-3.00	2.75-3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	\$0.111-\$0.121	\$0.111-\$0.121	\$0.131-\$0.14
Chinawood oil, bbl., lb.	.081	.091	.151
Coconut oil, Ceylon, tanks, N.Y., lb.	.051	.061	.071
Corn oil crude, tanks, (f.o.b. mill), lb.	.071	.071	.071
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.061	.061	.081
Linseed oil, raw, car lots, bbl., lb.	.10	.101	.163
Palm, Lagos, casks, lb.	.051	.061	.071
Niger, casks, lb.	.05	.06	.071
Palm Kernel, bbl., lb.	.061	.07	.081
Peanut oil, crude, tanks (mill), lb.	.07	.071	.081
Rapeseed oil, refined, bbl., gal.	.55-.58	.58-.60	.82-.84
Soya bean, tank (f.o.b. Coast), lb.	.081	.081	.091
Sulphur (olive foots), bbl., lb.	.061	.071	.09
Cod, Newfoundland, bbl., gal.	.53-.55	.53-.55	.65-.67
Menhaden, light pressed, bbl., gal.	.47-.49	.47-.49	.70-.72
Crude, tanks (f.o.b. factory), gal.	.20	.271	.43
Whale, crude, tanks, gal.	.78	.78	.80
Grease, yellow, loose, lb.	.041	.041	.071
Oleo stearine, lb.	.081	.081	.111
Red oil, distilled, d.p. bbl., lb.	.081	.09	.091
Tallow, extra, loose, lb.	.041	.05	.081

Coal Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	\$0.60-\$0.65	\$0.60-\$0.65	\$0.60-\$0.62
Refined, bbl., lb.	.80-.85	.80-.85	.85-.90
Alpha-naphthylamine, bbl., lb.	.32-.34	.32-.34	.35-.36
Aniline oil, drums, extra, lb.	.15-.151	.15-.151	.15-.16
Aniline salts, bbl., lb.	.24-.25	.24-.25	.24-.25
Anthracene, 80%, drums, lb.	.60-.65	.60-.65	.60-.65

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.70 - .72
Benzoin acid, U.S.P., kgs, lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech., dr., lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works, gal.	.21 - .23	.21 - .23	.22 - .23
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks., gal.	.60 - .70	.60 - .70	.73 - .75
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl., lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoluene, bbl., lb.	.16 - .17	.16 - .17	.17 - .18
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl., lb.	.39 - .40	.39 - .40	.45 - .47
H-acid, bbl., lb.	.68 - .70	.68 - .70	.63 - .65
Naphthalene, flake, bbl., lb.	.044 - .05	.044 - .05	.05 - .06
Nitrobenzene, dr., lb.	.084 - .09	.084 - .09	.084 - .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.52 - .53
Para-nitrotoluene, bbl., lb.	.29 - .30	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb.	.144 - .15	.144 - .15	.15 - .17
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.50 - 1.80	1.50 - 1.80	1.35 - 1.50
R-salt, bbl., lb.	.44 - .45	.44 - .45	.47 - .49
Resorcinol, tech., kegs, lb.	1.15 - 1.25	1.15 - 1.25	1.30 - 1.40
Salicylic acid, tech., bbl., lb.	.33 - .35	.33 - .35	.30 - .32
Solvent naphtha, w.w., tanks, gal.	.28 - .30	.28 - .30	.35 - .37
Tolidine, bbl., lb.	.91 - .93	.91 - .93	.95 - .96
Toluene, tanks, works, gal.	.35 - .37	.35 - .37	.35 - .37
Xylene, com., tanks, gal.	.25 - .28	.25 - .28	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	\$23.00-\$25.00	\$23.00-\$25.00	\$23.00-\$25.00
Casein, tech., bbl., lb.	.124 - .14	.134 - .15	.154 - .16
China clay, dom., f.o.b. mine, ton	8.00 - 20.00	8.00 - 20.00	10.00 - 20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.05 - .22	.05 - .22	.064 - .07
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.31 - .32
Ultramarine blue, bbl., lb.	.06 - .32	.06 - .32	.03 - .35
Chrome green, bbl., lb.	.27 - .28	.27 - .28	.27 - .30
Carmine red, tins, lb.	6.00 - 6.50	6.00 - 6.50	5.25 - 5.50
Para toner, lb.	.77 - .80	.77 - .80	.70 - .80
Vermilion, English, bbl., lb.	1.90 - 2.00	1.90 - 2.00	1.80 - 1.85
Chrome yellow, C. P., bbl., lb.	.17 - .174	.17 - .174	.154 - .16
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	5.75 - 7.00
Graphite, Ceylon, lump, bbl., lb.	.04 - .05	.04 - .05	.08 - .09
Cum copal Congo, bags, lb.	.07 - .09	.07 - .08	.074 - .08
Manila, bags, lb.	.16 - .17	.16 - .17	.15 - .18
Damar, Batavia, cases, lb.	.16 - .164	.16 - .19	.22 - .23
Kauri No. 1 cases, lb.	.48 - .50	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.), lb.	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnesite, calc, ton	40.00 - .00	40.00 - .00	40.00 - .00
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	5.60 - .00	6.15 - .00	9.40 - .00
Turpentine, gal.	.414 - .00	.434 - .00	.564 - .00
Shellac, orange, fine, bags, lb.	.43 - .44	.50 - .52	.61 - .62
Bleached, bonedry, bags, lb.	.28 - .30	.36 - .37	.56 - .60
T. N. bags, lb.	.21 - .22	.27 - .28	.46 - .47
Soapstone (f.o.b. Vt.), bags, ton	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	9.50 - .00	9.50 - .00	10.50 - .00
300 mesh (f.o.b. Ga.), ton.	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 - .00	13.75 - .00	13.75 - .00

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	\$0.21 - \$0.24	\$0.22 - \$0.24	\$0.28 - \$0.30
Beeswax, ref., light, lb.	.34 - .36	.35 - .36	.41 - .42
Candelilla, bags, lb.	.17 - .20	.18 - .20	.23 - .24
Carnauba, No. 1, bags, lb.	.28 - .29	.28 - .29	.50 - .51
Paraffine, crude 105-110 m.p., lb.	.04 - .044	.04 - .05	.044 - .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton.	\$200.00	\$200.00	\$200.00
Ferromanganese, 78-82%, ton.	94.00 99.00	94.00-99.00	105.00
Spiegelisen, 19-21%, ton.	33.00	34.00	32.00
Ferrosilicon, 14-17%, ton.	39.00	39.00	45.00
Ferrotungsten, 70-80%, lb.	1.10	1.20	1.35
Ferro-uranium, 35-50%, lb.	4.50	4.50	4.50
Ferrovanadium, 30-40%, lb.	3.15 3.50	3.15-3.75	3.15-3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	\$0.10	\$0.1075	\$0.18
Aluminum, 96-99%, lb.	.233	.233	.24 - .25
Antimony, Chin. and Jap., lb.	.071 - .084	.08 - .084	.094
Nickel, 99%, lb.	.35	.35	.35
Monel metal, blocks, lb.	.28	.28	.28
Tin, 5-ton lots, Straits, lb.	.268	.301	.424
Lead, New York, spot, lb.	.0505	.055	.069
Zinc, New York, spot, lb.	.0445	.045	.071
Silver, commercial, oz.	.364	.36	.494
Cadmium, lb.	.70 - .75	.70 - .75	.85 - .95
Bismuth, ton lots, lb.	1.00	1.00	1.70
Cobalt, lb.	2.50	2.50 - 2.50	2.50
Magnesium, ingots, 99%, lb.	.65 - 1.00	.85 - 1.10	.85 - 1.10
Platinum, ref., oz.	36.00	43.00 - 45.00	65.00 - 66.00
Palladium ref., oz.	22.00 - 23.00	23.00 - 24.00	42.00 - 46.00
Mercury, flask, 75 lb.	110.00 - 113.00	116.00	123.00
Tungsten powder, lb.	1.55 - 1.60	1.70 - 1.75	1.10 - 1.15

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton.	\$7.50 - \$8.00	\$7.50 - \$8.50	\$5.50 - \$8.75
Chrome ore, c.f. post, ton.	21.50 - 25.00	21.50 - 25.00	22.00 - 23.00
Coke, fdry., f.o.b. ovens, ton.	2.75 - 2.85	2.75 - 3.85	2.85 - 3.00
Fluorspar, gravel, f.o.b. Ill., ton.	18.00 - 20.00	18.00 - 20.00	17.00 - 18.00
Manganese ore, 50% Mn., c.i.f.			
Atlantic Ports, unit.	.31 - .36	.31 - .36	.36 - .38
Molybdenite, 85% MoS ₂ per lb.			
MoS ₂ , N. Y., lb.	.48 - .50	.48 - .50	.48 - .50
Monazite, 6% of ThO ₂ , ton.	60.00	60.00	130.00
Pyrites, Span. fines, c.i.f., unit.	.13	.13	.13
Rutile, 94-96% TiO ₂ , lb.	.10 - .11	.10 - .11	.11 - .13
Tungsten, scheelite, 60% WO ₃ and over, unit.	15.25 - 16.50	15.25 - 16.50	11.25 - 11.50
Zircon, 99%, lb.	.03	.03	.03

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Brass and Metal Plant—Tallman Brass & Metal Co., Cavell Ave., Hamilton, Ont., acquired a plant and plans the installation of equipment for the manufacture of bronze, aluminum castings and babbit metals.

Copper and Brass Tube Mill—Anaconda American Brass Co. Ltd., New Toronto, Ont., is having plans prepared for a 1 story, 80 x 400 ft. copper and brass tube mill. Estimated cost \$100,000. Private plans.

Brick and Tile Plant Equipment—Gomoll Bros. Brick & Tile Works, Powassan, Ont., W. Gomoll, Purch. Agt., plans the installation of complete equipment for the manufacture of colored flash and brick to double capacity of plant.

Kiln Plant—J. E. White Co., East Palestine, O., plans the construction of a continuous kiln plant for the manufacture of brick, sewer pipe and tile, at Negley. Estimated cost \$50,000. P. J. Crowl, East Palestine, will supervise work.

Carbon Plant—Spear Carbon Co., D. Miller, Gen. Supt., St. Marys, Pa., is receiving bids for a 1 story, 82 x 119 ft. carbon plant including three ton electric crane. C. Lyons, St. Marys, is engineer.

Cement, Liquid Chlorine, Sulphur Dioxide, etc.—City, B. S. Wemp, Mayor, City Hall, Toronto, Ont., will receive bids until Oct. 21, for annual supply of Portland cement, refined asphalt, liquid chlorine, pig lead, sulphur dioxide, etc.

Cement Plant—Yazoo Portland Cement Co., R. T. Miller, Pres. and Gen. Mgr., Nashville, Tenn., has option on site to construct a cement plant, 1,000,000 bbl. annual capacity at Vicksburg, Miss.

Ceramic Plant—Southwest Ceramic Products Co., Independence, Mo., plans the construction of a plant for the manufacture of Fayence tile, principally used for walls and floors at San Antonio, Tex. Estimated cost \$250,000.

Chemical Factory—Dewey & Almy Chemical Co., 235 Harvey St., Cambridge, Mass., is having plans prepared for a 1 story factory. Estimated cost exceeds \$40,000. H. L. Kennedy, 80 Boylston St., Boston, is architect.

Chemical Plant—Merrimac Chemical Co., Chemical Lane, Everett, Mass., awarded contract for a 1 story addition to plant to J. F. Griffin Co., 250 Stuart St., Boston. Estimated cost \$50,000.

Chemical Factory—Newport Chemical Co., Carrollville, Wis., awarded contract for a 4 story, 140 x 200 ft. factory to P. Riessen's Sons, 1022 Humboldt Ave., Milwaukee.

Chemical Warehouse—Brinkley Snowden and C. J. Haase, Memphis, Tenn., awarded contract for a 2 story, 50 x 175 ft. chemical warehouse at Pontotoc Ave. and South Front St., to S. Malkin, 479 North Manassas St., Memphis. Estimated cost \$40,000. Upjohn Chemical Co., Memphis, is lessee.

Clay Products Plant—Vigo-American Clay Co., Terra Haute, Ind., will soon award contract for the construction of new kilns in connection with plant. Estimated cost \$40,000. Private plans.

Color and Gum Works—Anchor Color & Gum Works, Dighton, Mass., awarded contract for a power unit to T. I. Ellis, 20 Alfred Stone Rd., Providence, R. I. Estimated cost \$42,000.

Cork Insulation Plant—Mitchell & Smith, Inc., Copeland St., Detroit, Mich. (cork insulation) awarded contract for a 1 story, 46 x 120 ft. addition to cooling plant to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost \$40,000.

Fertilizer Plant—Canadian Industries Ltd., R. Grubb, Purch. Agt., Hamilton, Ont., plans to purchase complete equipment for the manufacture of super-phosphate for plant.

Fireworks Plant—Unexcelled Mfg. Co., 22 Park Pl., New York, N. Y., plans the construction of a fireworks plant consisting of a group of small special buildings at Cranbury, N. J. Estimated cost \$100,000. Private plans. Work will be done by day labor and separate contracts. Maturity in fall of 1931.

Gas Plant, Gas Holder, Etc.—Syracuse Lighting Co., South Warren St., Syracuse, N. Y., plans extensions and improvements to plant to include complete new water gas plant, gas holder, pumping plant, office, etc. at Mechanics and Hiawatha Sts. Estimated total cost \$32,000,000. M. King, East Fayette St., Syracuse, is architect.

Gas Plant—Light & Heat Commission, J. Heeg, Mgr., Guelph, Ont., awarded contract for the construction of a new civic gas plant to West Gas Improvement Co., 441 Lexington Ave., New York, N. Y. \$107,000.

Gas Distribution Plant—Minnesota Power & Light Co., 30 West Superior St., Duluth, Minn., awarded contract for an 8 story building to be used in connection with gas distribution plant. An expenditure of \$2,000,000 will be involved in first unit which will also contain office quarters. Zenith Dredge Co., 13 Ave. M., Duluth, is contractor.

Gold Mining Plant—Wright Hargreaves Mines Ltd., Kirkland Lake, Ont., plans additions to gold mining plant including improvements to main head frame, complete new electric crusher unit, and increasing air compressor capacity. Estimated cost \$150,000. Private plans.

Chemistry Building—Massachusetts Institute of Technology, S. Stratton, Pres., 222 Charles River Rd., Cambridge, Mass., is having plans prepared for the construction of a 5 story chemistry building. Estimated cost to exceed \$40,000. Coolidge & Carlson, 89 State St., Boston, are architects.

Laboratory—Delta Experiment Station, W. E. Ayres, Dir., Stoneville, Miss., will soon award contract for the construction of a 4 story laboratory and office.

Laboratory—Department of Health, Division of Laboratories & Research, Albany, N. Y., will soon receive bids for alterations and extensions to main laboratory building. Estimated cost to exceed \$40,000.

Laboratory—New England Medical Center, J. A. Cousen, Pres. Tufts College, Boston, Mass., will soon award contract for a 5 story, 50 x 150 ft. nurses home and laboratory at Bennet and Ash Sts. Estimated cost to exceed \$40,000. Andrews, Jones, Biacoe & Whittemore, 50 Congress St., Boston, are architects.

Laboratory—New Jersey Bell Telephone Co., 540 Broad St., Newark, N. J., awarded contract for a 1 story laboratory at Deal, to J. Sutherland Co. Inc., 222 Main St., Asbury Park. Estimated cost \$40,000.

Laboratory—University of South Carolina, D. M. Douglas, Pres., Columbia, S. C., will receive bids about Nov. 1 for the construction of a 2 story laboratory building, etc. Estimated cost \$250,000. J. C. Johnson, Columbia, is architect. Equipment to cost \$50,000 will be required.

Laboratory—Windber Hospital, W. S. Wheeling, Windber, Pa., awarded contract for first unit of hospital, 2 story, 45 x 55 ft. including laboratory, etc., to Windber Construction Co., Windber. Estimated cost \$300,000.

Laboratory (Drug)—Brunwig Drug Co., 501 North Main St., Los Angeles, Calif., awarded contract for the construction of a 5 story 177 x 250 ft. laboratory on Second St. to MacDonald & Driver, Bld. of Trade Bldg., Los Angeles. \$350,000.

Laboratory (Medical)—Nathan Littauer Hospital, Gloversville, N. Y., awarded contract for a laboratory building to C. P. Boland & Co., 101 Park Ave., New York, N. Y. Estimated cost \$150,000.

Laboratory (Zoological and Botanical)—Wellesley College, E. F. Pendleton, Pres., Wellesley, Mass., awarded contract for the construction of a zoological and botanical laboratory on College grounds to L. D. Wilcutt & Sons Co., 146 Summer St., Boston. Estimated cost \$500,000.

Laboratories—Bd. of Education, N. W. Ladegard, Secy., Sidney, Neb., awarded contract for the construction of a 2 and 3 story, 171 x 194 ft. high school including laboratories, etc. to W. Knutzen, Kearney.

Laboratories—School Commissioners, Gary, Ind., will receive bids until Oct. 25 for a 3 story, 96 x 187 ft. high school including laboratories, etc. at 45th and Jackson Sts. Estimated cost \$1,000,000. W. B. Ittner, 911 Locust St., St. Louis, Mo., is architect.

Lead Products Plant—Hammond Lead Products Co., Hammond, Ind., awarded contract for the construction of a plant to F. C. Rowley, 611 Hohman St., Hammond. Estimated cost \$100,000.

Leather Factory—Horween Leather Co., 2015 Elston Ave., Chicago, Ill., awarded masonry and carpentry contracts for a 4 story, 40 x 75 ft. addition to plant.

Paint Manufacturing Plant—Corp., c/o H. Holder, 242 Franklin Ave., Brooklyn, N. Y., Archt., will receive bids late in November for the construction of a paint manufacturing plant. Estimated cost \$800,000.

Paint, White Lead, Etc.—A. L. Flint, General Purchasing Officer of the Panama Canal, Washington, D. C., will receive bids until Oct. 22, for drop black paint, white lead, dry vermilion, sienna, petroleum spirits, pine-tar oil, soluble cutting oil, etc.

Pottery Plant—Sebring Pottery Co., Sebring, O., manufacturers of potteryware, plans the construction of a 1 story warehouse in connection with plant. Estimated cost \$40,000.

Rayon Factory—Courtauld's Canada Ltd., Cornwall, Ont., is having plans prepared for a factory for the manufacture of rayon silk. Estimated cost \$500,000. Private plans.

Refinery—Gulf Refining Co., Frick Bldg., Pittsburgh, Pa., awarded contract for third and last unit of \$1,500,000 project at Neville Island to Landau Bros. Contracting Co., 125 First Ave., Pittsburgh. Plans include 24 x 113 ft. transfer pump house; 34 x 107 ft. treating plant pump house, 25 x 32 ft. accumulation building, 42 x 62 ft. compressor building, 61 x 79 ft. hot oil pump house, 18 x 25 ft. acid concentrator building, 46 x 85 ft. caustic plant, 30 x 36 ft. dye house, dye sulphur and clay storage and 16 x 22 ft. casing head pump house at Neville Island.

Refinery—International Nickel Co. Ltd., Coppercliff, Ont., awarded contract for structural steel to Dominion Bridge Co. Ltd., Lachine, Que. in connection with refinery unit No. 1 under construction by Fraser-Brace Engineering Co., 107 Craig St. W., Montreal, Que. \$500,000. Total estimated cost \$2,000,000.

Refinery—Leo Petroleum Co., c/o J. T. Flore, Ruse—Willmond Hotel Bldg., Harlingen, Tex., is having plans prepared for the construction of a 2 story refinery. Estimated cost \$125,000. Architect not announced.

Refinery—Sinclair Refining Co., 45 Nassau St., New York, N. Y., will build a refinery and transport facilities at Houston Ship Channel. Work will be done by day labor and separate contracts.

Refinery—Texas & Pacific Coal & Oil Co., Temple, Tex., plans the construction of a refinery for gasoline and oil by-products. Estimated cost \$500,000.

Refinery (Cotton Oil)—Chickasha Cotton Oil Co., Chickasha, Okla., awarded contract for the construction of a 3 story, 53 x 119 ft. cotton oil refinery to W. E. Edmiston, Chickasha.

Refinery (Oil)—Anglo-Saxon Petroleum Co., St., Hellens Court, London, England, had plans prepared for the construction of an oil refinery at Buenos Aires, Argentine.

Refinery (Oil)—Century Petroleum Co., Braniff Bldg., Oklahoma City, Okla., is having plans prepared for the construction of an oil refinery, 3,500 bbl. capacity at 1800 East 4th St., Oklahoma City. Estimated cost \$75,000. Private plans.

Refinery (Oil)—Magnolia Petroleum Co., Houston, Tex., plans enlargement of present refinery for gasoline, kerosene, gas fuel and fuel oils, at Luling. Hot oil units will be installed. Estimated cost \$110,000. Private plans. Work will be done by day labor.

Refinery (Oil)—Pennzoil Co., R. Fox, Drake Theatre Bldg., Oil City, Pa., awarded contract for an oil cracking unit to A. G. McKee & Co., 2422 Euclid Ave., Cleveland, O. Estimated cost \$500,000. Complete equipment will be required.

Refinery (Oil)—Rocky Mountain Refinery, Inc., c/o C. B. Stone, Chamber of Commerce, Pueblo, Colo., plans the construction of first unit of oil refinery, 1,000 bbl. daily capacity. \$100,000. Other units will be erected later.

Refinery (Sugar)—Superior Sugars Ltd., F. Potter, Purch. Agt., Petrolia, Ont., has taken over uncompleted buildings of Peninsular Sugar Co. and is interested in prices on complete machinery and equipment for sugar refinery.

Rubber Factory Addition—M. N. Shoemaker, 10 Bleeker St., Newark, N. J., Archt., will receive bids about Oct. 15, for a 2 story addition to factory at 361-65 6th Ave., for Weldron Roberts Rubber Co., 18 Oliver St., Newark. Estimated cost \$40,000.

Rubber Products Factory—International Rubber Co., c/o R. C. Sudbury, Maine Hotel, Pueblo, Colo., has work under way on first unit of factory for the manufacture of garden hose, inner tubes, fan belts and other rubber products. Total cost \$200,000.

Salt Plant—Morton Salt Co., 208 West Washington St., Chicago, Ill., plans the construction of a 1 and 2 story salt plant at Grand Saline, Tex. Estimated cost \$125,000. Part of work will be done by contract and part by day labor under the supervision of Allen & Garcia, McCormick Bldg., Chicago, Ill., Engrs.

Soap Manufacturing plant—Proctor & Gamble, 300 Avery St., Los Angeles, Calif., awarded contract for the construction of a group of buildings for soap manufacturing plant at Long Beach to Clinton Construction Co., Spring-Arcade Bldg., Los Angeles. \$750,000.

Smelter Stack—Calumet & Arizona Mining Co., Douglas, Ariz., awarded contract for a smelter stack, 36 in. in diameter at base, 20 ft. 6 in. diameter at top, to Kansas City Structural Steel Co., 218 Metropolitan Ave., Kansas City, Mo. Estimated cost \$70,000.

Sulphur Mill—Sunland Sulphur Co., J. H. Wright, Plant Supt., 2148 Inyo St., Fresno, Calif., is having plans prepared for the construction of a sulphur mill. Estimated cost \$75,000. Private plans.

INDUSTRIAL NOTES

SOUTHWESTERN PORTLAND CEMENT COMPANY has moved its general offices to 727 West 7th St., Los Angeles, Calif.

MACALASTER BICKNELL COMPANY is now located in its new building at Washington & Moore Sts., Cambridge, Mass.

ROLLER-SMITH COMPANY, 233 Broadway, New York, N. Y., has appointed J. K. Webb, 601 Allen Building, Dallas, Texas, as its sales agent for Texas.

FULLER LEHIGH COMPANY, Fullerton, Pa., has moved its office from the Traction Building to Carew Tower, Cincinnati, Ohio. H. E. Martin will continue in charge as manager.

PAIGE & JONES CHEMICAL COMPANY has purchased from the Permutit Company its zeolite and lime soda water softening and filter apparatus, which it has been manufacturing as licensee, but will continue the chemical branch of its business.

INTERNATIONAL MINERALS & METALS CORPORATION has moved its offices from 61 Broadway to 11 Broadway, New York, N. Y.

STANDARD VARNISH WORKS has acquired the business and good will of the National Varnish Company. J. W. Robson is president of the company.

SPROUT, WALDRON & COMPANY, Muncy, Pa., has appointed Edward F. Meschter, formerly with Link-Belt Company, as sales manager of its materials handling division.

CUTLER-HAMMER, INC., has moved its Philadelphia sales office to 401 North Broad St., Philadelphia, Pa., under the management of F. J. Burd.

CARBONDALE MACHINE COMPANY, Carbon-dale, Pa., has purchased the business of the refrigerating department of the Excelsior Motor Manufacturing & Supply Company, of Chicago, Ill.

STEPHENS-ADAMSON MFG. COMPANY, Aurora, Ill., has appointed Gordon F. Daggett as branch manager for its Wisconsin territory, with offices at 735 Briarwood Place, Milwaukee, Wis.

CHICAGO BRIDGE & IRON WORKS has moved its Cleveland offices to the Midland Bank Building, in charge of G. S. Sangdahl.

ST. JOHN X-RAY SERVICE CORPORATION has moved its laboratory to the Eveready Building, 30 Thomson Ave., Long Island City, New York.

FOXBORO COMPANY, Foxboro, Mass., has appointed C. C. Fuller as manager of its New York office.